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Improving Methods and Facilities for Cattle Slaughtering Plants in the Southwest

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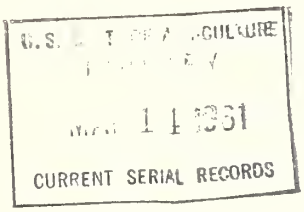

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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Transportation and Facilities Research Division

in cooperation with
Texas Agricultural Experiment Station

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PREFACE

This research was conducted cooperatively by the Texas Agricultural Experiment Station and the United States Department of Agriculture. Studies were conducted in 45 slaughtering plants in Texas. The purpose was to develop, for owners and managers of small plants which slaughter cattle and calves, a guide for reducing the costs of labor and equipment. The study deals with the physical layout of a one-bed plant and operations within the plant. Buying, selling, and other related work are not included.

The authors gratefully acknowledge the assistance of many individuals in the slaughtering industry in Texas. Plant operators made their plants available for detailed studies, and manufacturers of slaughtering equipment provided price data.

Joseph S. Stein, Chief Staff Officer for Facilities, Meat Inspection Division, Agricultural Research Service, made suggestions on technical problems of facility design and plant layout.

The work was conducted under the guidance and general supervision of George E. Turner, agricultural economist, Transportation and Facilities Research Division, Agricultural Marketing Service.

Definition of Terms

Base time is the time required for an operation to be performed at a normal pace by an operator skilled in the work.

Fatigue and personal allowances include 5 percent of the base time for personal needs and from 5 to 25 percent of the base time to compensate for weariness induced by the work. The percent allowance for fatigue is determined by the nature of the work. (See table 14 in the Appendix.)

Productive time is base time adjusted for fatigue and personal allowances.

Job regulated wait time consists of interspersed waiting periods resulting from irregular flow of work between crews.

Elapsed time is the amount of time consumed from the beginning to the end of an operation.

Split rail system is a system that consists of two parallel overhead dressing rails spaced 4 feet apart beginning at the rumping, backing, and eviscerating work station on the killing floor and ending at the wash rail. At the washing station, the rails consolidate to one rail. Cattle are suspended by trolleys, one hind leg to each rail, until the hide and viscera are removed and the carcass split into halves.

Monorail system involves the use of a single dressing rail in the place of two rails. The carcass is suspended by trolleys, both hind legs to the same rail, from the rumping, backing, and eviscerating work station through the rest of the operations.

One-bed killing floor is a layout which includes only one skinning bed.

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SUMMARY

Improved work methods and plant layout can reduce costs for the typical plant slaughtering 100 cattle daily by 50 cents a head or $13,000 annually. This reduction is based on the typical dressed weight slaughter ratio of 50 percent of the carcasses weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds. Labor and equipment requirements vary with these weight groups.

The total labor and equipment cost per 100 cattle for performing plant operations with typical work methods is $235.22, as compared to $184.68 with improved work methods. The labor cost with typical work methods is $216.37; the equipment cost, $18.85. The labor cost with improved methods is $165.21; the equipment cost, $19.47. All of the reduction in the costs for slaughtering with improved methods and layout occurs in the cost of labor. The equipment costs are slightly higher.

Labor and equipment costs are computed for various methods used in each major operating cycle: Killing floor, hide room, viscera washing and separating room, chilling and holding coolers, boning room, load-out dock, offal chilling cooler, equipment washroom, and plant cleaning. A reduction in cost is incurred with the improved work methods and layout in all operating cycles except plant cleaning. The cost for plant cleaning is increased because the improved layout has a larger overall area.

The largest reduction in cost is incurred in the killing floor operating cycle. The cost for killing floor operations is reduced from $156.69 per 100 cattle with typical methods and layout to $118.87 with improved methods and layout. The use of improved methods requires less labor and permits operations to be more evenly divided among workers, thereby reducing the unproductive labor.

A layout is suggested for a plant slaughtering 100 cattle daily of the same weight ratios as are killed in a typical plant slaughtering the same volume. The major components of the suggested plant are: Holding pens, killing floor, chilling and holding coolers, hide cellar, viscera washing and separating room, boning room, load-out dock, offal chilling cooler, freezer room, offices, machinery rooms, and welfare room. The layout shows the arrangement for the most direct flow of cattle, carcasses, and meat byproducts through the plant, and also a possible arrangement of equipment and work areas. The layout of the suggested plant, expanded to handle a daily volume of 150 cattle, also is shown. The expansion would require a space increase of 60 percent of the original area of the holding pens and 19 percent of the plant proper.

IMPROVING METHODS AND FACILITIES FOR CATTLE SLAUGHTERING PLANTS IN THE SOUTHWEST

by DONALD R. HAMMONS, *industrial engineer*, Transportation and Facilities Research Division, Agricultural Marketing Service, and JARVIS E. MILLER, *agricultural economist*, Department of Agricultural Economics and Sociology, Texas Agricultural Experiment Station

INTRODUCTION

Many changes have occurred in the meat industry in the Southwest in recent years. Among the more important changes has been the increased number of small specialized cattle slaughtering plants which are located near both livestock producing areas and meat consuming centers. Many of these plants have developed since 1940. Major factors contributing to this growth are an improved transportation system, population growths and shifts, the changing structure of the retail food industry, wider use of Federal meat inspection and grading, and changes in the relative value of byproducts.

Few of these plants were planned and constructed with the benefit of technical assistance. As a result, the arrangement of component parts of most plants does not provide for a direct flow of products between departments with a minimum of handling. Work stations are not always located to provide the shortest distances of movement for meat products. The result is excessive labor. A majority of these smaller plants are also plagued with inadequate space for chilling and holding meat. Some plants are still operating with obsolete equipment.

This study was undertaken to: (1) Measure the relative efficiencies of various work methods and types and combinations of types of equipment used in one-bed slaughter plants; (2) compare the various combinations of work methods and equipment to determine their effects on total plant costs; (3) determine the effects of carcass weight on labor and equipment requirements; and (4) develop layouts with equipment arrangements.

Research Methods

Research was conducted in slaughtering plants in Texas to cover all basic types of materials-handling equipment currently used and all significant variables that affect the use of the equipment. Such variables include: (1) Layout and design of facility; (2) size and weight of animals slaughtered; (3) number of workers in a crew; (4) crew organization and sequence of operations; and (5) equipment arrangement.

Such variables as (1) the condition of the animal before slaughter, and (2) grade and type of animal, which may affect some operations in the plant, are not specifically evaluated because studies included all types of animals, and labor and equipment requirements represent the average. No attempt has been made to evaluate work done by inspectors and graders. The study is concerned primarily with in-plant handling and processing operations.

Preliminary observations and studies were made in 45 plants in Texas to observe the methods and equipment used for slaughtering cattle. Time studies were made in 16 of these plants which were selected as representative of the industry.

Time studies were made of the various work methods to: (1) Determine the elapsed time required to perform operations; (2) determine the total man-hours of labor and total machine-hours of equipment required; (3) determine the amount and location of delays, and other nonproductive time during operations; and (4) provide a basis for developing improved work methods, plant layout, and equipment arrangement.

From observations and time studies, a layout of a one-bed plant, considered typical in Texas of plants slaughtering approximately 100 cattle daily, was prepared. Labor and equipment requirements and costs were computed for the various operations and types of equipment typical of a plant of this type. From this information, the total labor and equipment requirements were developed. A comparison of typical costs with costs of proposed methods shows efficiencies that can be brought about by changes in methods and equipment.

There are also many variations in the methods of operations and the byproducts handled. This study, however, is limited to selected methods, types of equipment, and to plants handling fresh meat, and is not intended to answer all problems or to cover all conditions in slaughter plants.

Labor costs are based on the productive labor required for the operation plus the amount of idle time inherent in the method. Wait time resulting from irregular flow of work between

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workers is computed for the line operations on the killing floor. Equipment costs are computed for 100 animals and allocated to the separate operations according to the elapsed time.

Buying, selling, management, and facility costs have not been included; therefore, the data do not reflect total plant costs.

Assumed Wage Rates

A wage rate of $1.25 per hour is assumed as the average rate for unskilled labor in a slaughter plant. Semi-skilled labor is computed on the basis of $1.60 per hour; and skilled labor, $2.00 per hour. Boners' wages are computed on the basis of $2.50 per hour. In a small plant, it is often necessary for skilled labor to perform semi-skilled or unskilled jobs in addition to their regular duties. Conversely, unskilled labor may be required to perform semi-skilled jobs. Supervisory personnel are not included.

Equipment Costs

Data on equipment costs were obtained from manufacturers and are based on average f.o.b. factory prices for 1957 and 1958. These costs are grouped into two major categories, ownership costs and operating costs. (See table 13 in the Appendix.)

Ownership costs are considered to be fixed and include depreciation, taxes, interest, and insurance. Interest rates are based on 6 percent of the average investment, and a combined figure for taxes and insurance is based on 4 percent of the initial investment. Operating costs are based on representative costs of electricity, water, and maintenance in Texas slaughter plants. All costs are computed on an annual basis.

SLAUGHTER PLANT OPERATIONS

For the purpose of analyzing labor and equipment requirements, slaughter plant operations are divided into 9 major operating cycles. These are: (1) Killing floor; (2) hide room; (3) viscera washing, and separating room; (4) chilling and holding coolers; (5) boning room; (6) load-out dock; (7) offal chilling cooler; (8) equipment washroom; and (9) plant cleaning. The operations within each cycle are analyzed according to the equipment and methods used. The total labor and equipment requirements are computed for one day for plants slaughtering 100 cattle daily.

Most plants slaughtering 100 cattle daily bone out some carcasses. The number boned varies widely among plants. Research studies show, however, that the typical plant in Texas bones out about 10 percent of its slaughter. Therefore, it is assumed that the plant for which labor and equipment requirements are computed would bone out 10 carcasses, and the meat would be sold as fresh meat, and that 90 carcasses would be sold fresh in carcass form.

Field studies showed that labor and equipment requirements for various operations are affected materially by the weights of the animals slaughtered. Major differences occur at the following dressed weight levels: 150 to 349 pounds; 350 to 599 pounds; and 600 to 900 pounds. Some minor variation occurs within each weight group. In a few operations, cattle are handled in groups. In driving, for example, four animals of the small weight group are driven into the knocking pen at one time, two of the middle weight group, and one of the large weight group. Table 14 shows the frequency at which each time item occurs within a cycle and the labor requirements for performing the time items for carcasses of each weight group.

Very few plants in Texas slaughter cattle of only one weight group. Most of them slaughter cattle of all weights by lot numbers; this necessitates changes from one weight group to another during the daily kill. Research studies show that the ratio of weights of cattle slaughtered by a typical plant would consist of 50 percent of the animals weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weights). Labor and equipment requirements are based on a plant slaughtering animals of this ratio of weights. A significant variation from this ratio would alter labor requirements or daily kill capacity.

Labor and equipment requirements are computed for various methods used in each major operating cycle. The requirements are affected materially by the distances of movement of products between work stations and plant departments. The distances vary widely from plant to plant because of variations in plant layouts or in the arrangement of equipment. The average distances by methods commonly used are based on the typical layout of a one-bed plant slaughtering 100 cattle daily (fig. 16). The average distances with the improved work methods and labor saving devices are based on the proposed layout for a plant of the same capacity (fig. 17).

Slaughter plant workers have different job classifications and wage rates because of the varying skills required. Some operations require both skilled and unskilled or semi-skilled labor. Frequently skilled workers do the job of the unskilled worker. Therefore, to reduce the cost of an operation, reduce the amount of skilled labor performing unskilled work.

Operating methods are divided into two groups for purposes of comparison. Combination A methods are those commonly used by one-bed slaughter plants and are based on the typical layout. Combination B methods are improved work methods based on the use of labor saving devices and a proposed layout.

For this study, it is assumed that: (1) Hearts, livers, tails, head and cheekmeat, tongues, and tripe will be processed as edible offal; (2) hides will be processed and cured; (3) all other edible and inedible offal will be sent to a rendering plant; (4) no portion of the volume will be handled as condemned material; (5) animals of the typical weight group are processed at the rate of 100 per day, 260 days per year; (6) knives, aprons, boots, etc., are employee's equipment; therefore, no equipment cost is allocated for these items; and (7) no kosher slaughter is conducted.

The times established for specific operations should not be considered as standards but as guides for measuring the relative efficiencies of the methods of operations.

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FIGURE 1.—Covered holding pens of pipe construction.

Killing Floor Line Slaughtering Operations

Killing floor operations are divided into two types, line slaughtering and supporting. (Supporting operations are described p. 13.) Line slaughtering transforms an animal into a finished carcass. The operations are performed in sequence and are dependent upon one another; therefore, a significant delay in any one of the line operations will result in a delay to all line operations.

Line slaughtering operations include: (1) Driving; (2) immobilizing; (3) dumping; (4) dry landing; (5) bleeding and head skinning; (6) flooring; (7) rumping, backing, and eviscerating; (8) dropping hide and sawing carcass; (9) washing; (10) shrouding; and (11) weighing. During the dry landing operation, the animal is hoisted onto a bleeding rail and remains on this rail through the next operation. The carcass is dropped from the rail for the flooring operation, supported from a hoist and spreader for the rumping, backing, and eviscerating operations, and suspended from dressing rails for all of the remaining killing floor operations.

Time items have been arranged to make up operations in the various methods on a comparative basis; therefore, certain time items may not be discussed in the same order that they are actually performed.

Driving

Driving cattle from the catch pens area through a chute into a knocking pen is the first operation in slaughtering. Labor required for unloading, sorting, and cleaning in the holding pen area (fig. 1) and for driving cattle from the holding pens to the catch pen has not been evaluated in this study. Two methods of driving cattle are the corner drive and the straight drive. Each method is performed manually.

The factors affecting the time required for driving are: (1) The breed and class of cattle; (2) the distances of the drives; and (3) the type of chute. Some breeds of cattle, such as the Brahma, appear to be more excitable and cause some delay in driving. However, the time items shown are based on averages of the different breeds handled, and take into account time delays caused by the unpredictable actions of cattle.

The catch pens, chutes, and knocking pens used by both methods are considered to be a part of the facility, and no equipment costs are involved.

CORNER DRIVE METHOD.—A worker walks from the bleeding pit to the catch pen and drives cattle from the catch pen to the knocking pen. The average distance from the bleeding pit to the catch pen is 50 feet and the average distance from the catch pen to the knocking pen is 30 feet. In the typical plant, the worker drives cattle through a chute with a right angle turn (fig. 16). The elapsed time required to drive 100 cattle of typical weight from the catch pen into the knocking pen is 1.77 hours.

The labor requirement per 100 cattle for driving from the catch pen into the knocking pen by the corner drive method is 1.77 man-hours; the labor cost is $2.83.

STRAIGHT DRIVE METHOD.—A worker walks an average distance of 45 feet from the bleeding pit area to the catch pen. The cattle are driven through a straight chute into the knocking pen (fig. 17), an average of 25 feet. The elapsed time required for driving 100 cattle is 1.51 hours.

The labor requirement is 1.51 man-hours; the labor cost is $2.42.

COMPARISON OF TWO METHODS.—Table 1 shows a cost comparison for driving by the two methods. The labor cost for the straight drive method is $0.41 less than for the corner drive, owing to an arrangement of facilities which provides for shorter walking and driving distances. Furthermore, cattle hesitate less when being driven through a straight chute. All of the reduction is in labor cost since no equipment cost is involved.

TABLE 1.—*Labor and equipment requirements and costs per 100 cattle for specified operations by designated methods in plants slaughtering 100 cattle daily* [1]

Operation and method	Elapsed time	Labor and equipment requirements		Labor and equipment costs		
		Labor	Equipment	Labor	Equipment	Total
	Hours	*Man-hours*	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*
Driving cattle:						
Corner drive	1. 77	1. 77	----------	2. 83	----------	2. 83
Straight drive	1. 51	1. 51	----------	2. 42	----------	2. 42
Dumping:						
Sliding door	. 18	. 18	0. 22	. 29	0. 35	. 64
Revolving door	. 09	. 09	. 02	. 14	. 32	. 46
Dry landing:						
Nonautomatic	1. 96	1. 96	5. 67	3. 14	. 73	3. 87
Automatic	1. 50	1. 50	5. 76	2. 40	1. 00	3. 40
Bleeding and head-skinning:						
Long rail	4. 27	4. 27	12. 41	6. 83	. 27	7. 10
Short rail	4. 07	4. 07	11. 93	6. 51	. 26	6. 77
Flooring:						
Pritch plate	7. 57	15. 14	38. 97	30. 28	. 70	30. 98
Cradle	6. 48	12. 96	34. 20	25. 92	. 72	26. 64

[1] Based on 50 percent of animals weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weight).

Immobilizing

Cattle are stunned in the immobilizing operation. This is done in the knocking pen, a narrow enclosure built to hold from one to five cattle, depending on the size of the animals. Cattle enter through a gate at one end of the pen and are transferred to the killing floor through a large door which, when closed, serves as one side of the knocking pen. The worker stands on an elevated platform at the rear of the knocking pen. This pen is considered a part of the facility.

At the time this study was made, two methods were commonly used in Texas plants. One was with a .22 calibre rifle, the other, with a 4- or 5-pound hammer. However, in this study, only the rifle method is considered.

RIFLE METHOD.—A worker shoots cattle with a rifle to immobilize them. For safety purposes, the rifle used is a single shot type that must be replaced in a rack after each firing, and is kept unloaded when not in use. This method can be hazardous to workers on the killing floor because of the possibility of ricocheting bullets. The elapsed time required for immobilizing 100 cattle is 0.59 hours.

The labor requirements are 0.59 man-hours, and the labor cost is $0.94. The equipment cost is $0.08, based on the use of a single shot rifle for 0.59 machine-hours. The total cost of immobilizing 100 cattle is $1.02.

Dumping

Dumping includes moving cattle from the knocking pen onto the dry landing area adjacent to the pen. The two methods of dumping are the sliding door and the revolving door. In each method, one worker performs the operation.

SLIDING DOOR METHOD.—A sliding door, which is hoisted vertically, is utilized. After immobilizing the animals, the worker walks an average distance of 15 feet from the knocking pen platform to the dry landing area. The worker hoists the knocking pen door to allow access to the animals for shackling, then closes the door.

Table 1 gives the elapsed time for the operation and the labor and equipment requirements and costs. The equipment cost is based on the use of a sliding knocking pen door and a hoist for 0.11 machine-hour each.

REVOLVING DOOR METHOD.—Dumping cattle by this method involves: (1) Releasing pen door catch, and (2) walking to dry landing area (average distance, 15 feet). The revolving door requires no power. It is suspended on a central axle and is balanced so that it automatically swings shut and latches after the cattle are dumped on the dry landing area. The worker releases the latch to allow the immobilized animals to fall onto the dry landing area, then walks to the dry landing area. The elapsed time required for dumping 100 cattle of the typical weight group is 0.09 hour.

The labor and equipment requirements and costs are given in table 1. The equipment cost is based on the use of a revolving door for 0.02 machine-hour.

COMPARISON OF TWO METHODS.—The total cost for dumping 100 cattle by the revolving door method is $0.18 less than by the sliding door method. The major portion of the reduction is in labor costs. This labor saving results because the revolving type door eliminates the need for hoisting and closing the door. The revolving door method reduces equipment costs by 3 cents, primarily because no hoist is needed (table 1).

Dry Landing

Dry landing involves the work of shackling the animal by its hind legs and raising it with an electric hoist to the bleeding rail. The animal is trans-

ferred to the rail and manually pushed to the bleeding pit for bleeding and head skinning. Dry landing is done in a separate curbed and drained area adjacent to the knocking pen. A 4-foot-high pipe guard rail also separates this area from the rest of the killing floor.

Two methods are used in dry landing cattle, the nonautomatic and automatic methods. In each method, one worker performs the operation.

Nonautomatic method.—To dry land by this method, the worker shackles the hind legs of the animal, hoists the animal to the bleeding rail (16 feet above the floor), moves the animal 8 feet on the rail to the bleeding pit, lowers the hoist, picks up the shackle from the floor, places it on the hoist hook, and walks 15 feet to the bleeding pit for the next operation.

The shackle chain is looped around the hind legs just above the ankles. Because the guiding device for transferring cattle to the bleeding rail is nonautomatic, the worker must manually guide the carcass to align the trolley with the rail.

Table 1 lists labor and equipment requirements and costs. Equipment cost is based on the use of 15 beef shackles, 8 feet of bleeding rail, and a hoist with nonautomatic lander, for 1.89 machine-hours each.

Automatic method.—A hoist with a device which automatically guides the trolley onto the bleeding rail is used with the automatic method. The worker shackles the animal by its hind legs and hoists it onto the bleeding rail. The average distance for moving the animal to the bleeding pit is only 6 feet and the average distance for walking is 10 feet. The worker takes the shackle from a shackle return rail instead of from the floor.

See table 1 for labor and equipment requirements and costs. Equipment cost is based on the use of 15 beef shackles, 5 feet of bleeding rail, 12 feet of shackle return rail, and a hoist with automatic lander, for 1.44 machine-hours each.

Comparison of two methods.—The labor and equipment cost for dry landing by the nonautomatic method is $3.87 as compared with $3.40 for the automatic method (table 1).

The labor saving of 0.46 man-hour results from less time being required to guide the animal while it is being hoisted, a shorter distance of moving the animal on the rail, a shorter walking distance to the bleeding pit, and less time required to obtain the shackles from a return rail. The reduction in labor cost by the automatic method is $0.74.

The equipment cost, however, is higher with the automatic method due to the cost of the automatic landing device.

Bleeding and Head Skinning

Bleeding and head skinning involves sticking the animal and allowing it to bleed until the initial flow of blood subsides, skinning the head, removing the ears, and trimming the hide. The operation is performed in a bleeding pit bordered by a low curb and equipped with a combination blood and water drain (fig. 2). A bleeding rail extends over the pit for suspending and moving cattle through it. After the head is skinned, it is cut free from the carcass and left hanging by the trachea and esophagus.

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Figure 2.—Portion of killing floor showing the bleeding area in the background, skinning beds in the center and the half-hoist position for rumping in the foreground.

Two methods are used, the long rail and the short rail. Only one worker is needed regardless of method.

Long rail method.—A worker, using a hand knife, sticks the animal and allows it to bleed. After the initial flow of blood subsides, he skins the head, removes the ears, and trims the hide. He then moves the carcass out of the pit. Between each operation he usually moves the carcass within the pit, and after he skins the head, he attaches a tag on which he has written the lot number to identify the head with the carcass. He walks 15 feet to the lavatory, and washes and rinses his hands and knife. The average distance cattle are moved within the pit is 20 feet.

Table 1 gives requirements and cost figures. The equipment cost is based on 15 shackles, 26 feet of bleeding rail, a blood and water drain, for 4.11 machine-hours each, and a sterilizing lavatory for 0.08 machine-hour.

Short rail method.—Bleeding and head skinning is performed in the same manner with the short rail method as with the long rail method. However, the short rail method requires a move ment of only 10 feet in moving cattle through the bleeding pit. Furthermore, the location of the lavatory in relation to the pit requires the worker to walk only 5 feet to sterilize his knife.

See table 1 for requirements and cost details. The equipment cost is based on 15 shackles, 13 feet of bleeding rail, a blood and water drain, for 3.95 machine-hours each, and a sterilizing lavatory for 0.08 machine-hour.

Comparison of two methods.—The labor and equipment cost is $0.33 per 100 cattle less for the short rail method than for the long rail method (table 1). All of the reduction is in the cost of labor and is due to an improved plant layout where cattle are moved a shorter distance. The distance of movement of cattle in the bleeding pit is reduced from 20 feet with the long rail method to 10 feet with the short rail method. The walking distance to sterilize the knife is 15 feet with the long rail method and 5 feet with the short rail method. The equipment cost is practically the same for both methods.

Flooring

For the purpose of this analysis, flooring includes moving the carcass on the bleeding rail to the skinning bed, lowering it onto the bed, removing the legs, and skinning the side. A skinning bed is an area on the killing floor with a cradle (fig. 3) or two pritch plates for positioning carcasses on their backs.

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Figure 3.—Positioning a carcass in a cradle.

The two methods for flooring are the pritch plate and the cradle method. Two workers, as a team, perform the operation with each method. A worker with a hand skinning knife works on each side of the carcass. Because of crew interference, it is not practical to use more than two workers on the flooring operation. To attain the highest degree of efficiency, with both methods, the work must be divided as evenly as possible between the two workers.

Pritch plate method.—One worker walks from the skinning bed area to the bleeding pit and moves a carcass on a rail an average distance of 8 feet to the skinning bed area where the pritch plates are located. With the aid of a friction dropper, he drops the carcass on the floor between the pritch plates. The other worker braces the carcass to the plate with a pritch bar, so that it lies on its back. The side on which the pritch bar is located is called the pritch side, the other the paunch side. One worker removes the shackle from both the carcass and dropper hook, carries it 10 feet to the dry landing area, and drops it on the floor, while the other worker returns the friction dropper hook to its rail position.

A worker, standing on the pritch side, skins and removes one front and one hind leg, throws them into a barrel, makes a belly incision, partially skins the side, moves the pritch bar to the paunch side, then finishes skinning the side, splits the aitch bone either with a hand knife or a hand meat saw, and then sterilizes his knife.

A worker located on the paunch side, skins and removes one front and one hind leg, throws them into a barrel, ties the weasand, skins the side, saws the brisket with a hand meat saw, attaches the trolleys to the hocks, and sterilizes his knife.

Table 1 gives the labor and equipment requirements and costs. The labor requirements include 0.46 man-hour of unproductive labor because the worker on the paunch side waits for the worker on the pritch side. The equipment cost is based on 8 feet of bleeding rail, a friction dropper assembly, pritch plates with bar, hand meat saw, and 200 trolleys, for 7.57 machine-hours each, 15 shackles for 0.94 machine-hour, and a sterilizing lavatory for 0.18 machine-hour.

Cradle method.—A worker walks to the carcass hanging in the bleeding and head skinning area and manually moves it on the rail a distance of 6 feet to the skinning bed, where it is rolled onto a friction dropper hook. He then actuates a friction dropper to lower the carcass on its back into a cradle. The cradle (usually made of 2-inch galvanized pipe) holds the carcass steady. It is adjustable for handling carcasses of different sizes. The worker actuates a switch to return the dropper hook to the rail position, skins and removes both forelegs, throws them into the gravity chute, ties the weasand, cuts the hide from brisket to bung, skins the side, and saws the brisket with a hand meat saw. He then walks to the lavatory and sterilizes his knife.

The other worker, on the opposite side of the carcass, grasps the forelegs and guides the carcass into the cradle while it is being lowered, removes the shackle from both the hind legs and dropper hook, and places the shackle on the return shackle rail. He then skins and removes each hind leg, throwing each into a gravity chute, and attaches the trolleys to the hocks of the carcass. He then skins one side, splits the aitch bone, and sterilizes his knife.

See table 1 for figures as to requirements and costs. Included in the labor requirements is 0.10 man-hour of unproductive labor because one worker waits for the other worker to move the carcass to the cradle. The equipment cost is based on the use of 6 feet of bleeding rail, a cattle cradle, a friction dropper assembly, 200 trolleys, and a hand meat saw for 6.48 machine-hours each,

15 shackles and 12 feet of shackle return rail for 0.81 machine-hour each; and a sterilizing lavatory for 0.18 machine-hour.

Comparison of two methods.—A $4.34 reduction in cost per 100 carcasses is shown by the use of the cradle method (table 1). All of this reduction occurs in the cost of labor and is a result of: (1) Shorter distance required in moving carcasses to the cradle; (2) elimination of the pritch bar; (3) less stooping for workers (allowing for a smaller fatigue factor); (4) shorter walking distances to dispose of shackles; (5) less walking because the sterilizing lavatory is closer to work area; and (6) more evenly balanced workload between workers.

A reduction of 1.09 hours of elapsed time per 100 cattle is also possible with the cradle method. However, by the pritch plate method, the equipment costs are 2 cents less per 100 cattle than for the cradle method, mainly because of the higher cost of the cradle.

The shackle return rail used with the cradle method is a short section of rail that permits shackles to be returned to the dry landing area by gravity movement.

Rumping, Backing, and Eviscerating

In most of the plants studied, the rumping, backing, and eviscerating operation paces all line operations. A reduction in the elapsed time for the operation would decrease the amount of wait time all along the line. Most of the work in rumping, backing, and eviscerating is done while the carcass is suspended by its hind legs from a hoist. Part of the work, however, is done while the carcass is suspended from a split rail or monorail. Three methods are used, the split rail one worker, the split rail two worker, and the monorail.

Split rail one worker method.—The worker half-hoists the carcass, skins the rump and back, positions the paunch truck under the carcass brisket, eviscerates, moves the paunch truck to the truck holding areas (fig. 4), transfers the carcass onto the dressing rail, and transports it on the rail to the dropping-hide and carcass-sawing area. He sterilizes his knives and washes his hands during the cycle of operations. Each carcass is transferred onto two overhead dressing rails 4 feet apart. The carcass is spread between the rails with a hind leg attached to each rail so that it may be transported back-first to the next working area.

Table 2 lists labor and equipment requirements and costs. The equipment cost is based on 200 trolleys, 14 feet of dressing rail, and a hoist with

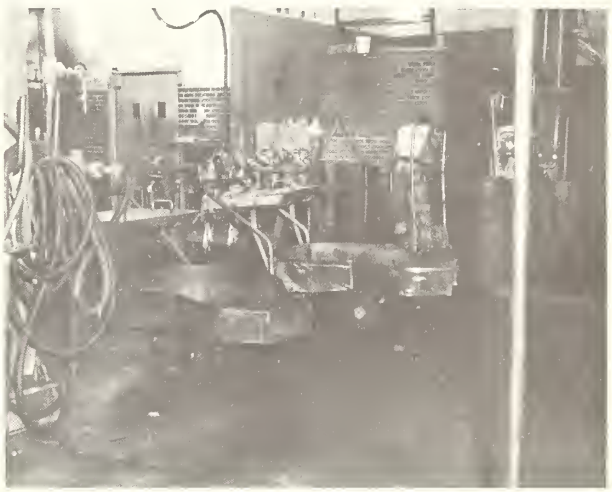

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Figure 4.—Paunch trucks used for transporting viscera.

Table 2.—*Labor and equipment requirements and costs per 100 cattle for specified operations by designated methods, in plants slaughtering 100 cattle daily* [1]

Operation and method	Elapsed time	Labor and equipment requirements		Labor and equipment costs		
		Labor	Equipment	Labor	Equipment	Total
	Hours	*Man-hours*	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*
Rumping, backing and eviscerating:						
Split rail one worker	11. 23	11. 23	33. 87	22. 46	0. 85	23. 31
Split rail two worker	8. 79	10. 58	26. 46	19. 82	. 85	20. 67
Monorail	7. 96	9. 88	23. 97	18. 42	. 85	19. 27
Dropping hide and sawing carcass:						
Split rail	7. 35	7. 35	21. 55	11. 76	2. 07	13. 83
Monorail	6. 56	6. 56	20. 51	10. 50	2. 01	12. 51
Hydraulic lift	6. 38	6. 38	22. 65	10. 21	3. 37	13. 58
Washing carcass:						
Split rail 1-level platform	5. 09	5. 09	19. 69	6. 36	1. 83	8. 19
Monorail 2-level platform	4. 25	4. 35	17. 00	5. 44	1. 88	7. 32
Shrouding carcass:						
1-level platform	4. 92	4. 92	14. 46	6. 15	. 13	6. 28
2-level platform	2. 53	2. 53	7. 25	3. 16	. 09	3. 25
Weighing carcass:						
Beam scale	3. 00	3. 00	7. 96	3. 75	. 39	4. 14
Dial scale	2. 59	2. 59	7. 04	3. 24	. 60	3. 84

[1] Based on 50 percent of animals weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weight).

double rail spreader, for 11.23 machine-hours each, and a sterilizing lavatory for 0.18 machine-hour.

SPLIT RAIL TWO WORKER METHOD.—Essentially the same work is performed with the split rail two worker method as with the split rail one worker method. With the two worker method, one worker half-hoists, rump skins, back skins, transfers the carcass to the dressing rail, and transports the carcass on the dressing rail to the dropping-hide and carcass-sawing area. The other worker positions the paunch truck under the carcass brisket, eviscerates, and removes the truck from the eviscerating area. The labor requirements for positioning the truck under the brisket and removing it from the eviscerating area are charged to the operation of removing viscera from the killing floor because the work is a part of that operation.

See table 2 for labor and equipment requirements and costs. Equipment cost is based on 200 trolleys, 14 feet of dressing rail, a hoist with a double rail spreader, for 8.79 machine-hours each, and a sterilizing lavatory for 0.09 machine-hour.

MONORAIL METHOD.—Three workers perform the rumping, backing, and eviscerating operation. One worker is engaged full time. He half-hoists the carcass, with the assistance of a worker assigned to the flooring operation who devotes part of his time to rumping, backing, and eviscerating. The worker assigned to flooring attaches the spreader to the hind legs of the carcass when it is swung to him by the full time worker, and 0.13 hour of his time is charged to rumping, backing, and eviscerating. The full time worker also rump skins, back skins, transfers the carcass to the dressing rail, and transports carcasses on the rail to the dropping-hide and sawing-carcass area. Another part-time worker positions the paunch truck under the carcass brisket, eviscerates, and removes the truck from the work station. The labor requirements for positioning and removing the truck are charged to the operation of removing viscera from the killing floor. Each carcass is transferred onto the overhead dressing rail with a single rail lander.

See table 2 for labor and equipment requirements and cost figures. The equipment cost is based on 200 trolleys, 7 feet of dressing rail, a hoist with a single rail lander, for 7.96 machine-hours each; and a sterilizing lavatory for 0.09 machine-hour.

COMPARISON OF THREE METHODS.—The labor and equipment cost for rumping, backing, and eviscerating 100 carcasses of the typical weight group by the split rail one worker method is $23.31, as compared with $20.67 for the split rail two worker method and $19.27 for the monorail method. The equipment cost is the same with all three methods.

The labor requirements and cost are less with both the monorail and split rail two worker methods than with the split rail one worker method. Part of the reduction in cost is because the wage rate for the worker who eviscerates is lower than that for the workers who work full time. Labor is saved also with the monorail method because less time is required for half-hoisting the carcass and transferring it to a monorail.

The split rail one worker method takes more time than the other two. When workers perform different jobs simultaneously the result is less time.

See table 2 for comparative figures as to requirements and costs by these three methods.

Dropping Hide and Sawing Carcass

Dropping hides and sawing carcasses consists of skinning the neck and allowing the hide to drop to the floor, splitting the carcass down the center of the backbone, and scribing each half. An electric beef carcass saw is used to halve the carcass. The saw is suspended at the carcass sawing work area and is counterbalanced so that it can be easily raised or lowered.

Three methods are used: (1) The split rail; (2) the monorail; and (3) the hydraulic lift. Each method requires only one worker.

SPLIT RAIL METHOD.—Dropping hide and sawing carcass with this method involves: Sawing carcass; dropping hide; putting hide in barrel; sawing neck; moving carcass on rails; scribing; and sterilizing knife. The worker stands on the killing floor facing the back of the carcass and saws it down the center of the backbone to the point where the hide is attached to the neck. He skins the neck to drop the hide from the carcass. He then finishes sawing the neck to complete the separation of the carcass into halves. The half carcasses are moved on the rail (average distance 4 feet) to the area where each half carcass is scribed. Scribing includes cutting the "fin" bones almost through with a hand-type scribe saw and pounding them back to give a broader effect to the back. The worker then sterilizes his knife to be ready for the next carcass.

Table 2 gives the labor and equipment requirements and costs. The equipment cost is based on 200 trolleys and 16 feet of dressing rail for 7.35 machine-hours each, a saw sterilizer and beef carcass saw for 3.12 machine-hours each, a scribe saw for 0.52 machine-hour; and a sterilizing lavatory for 0.09 machine-hour.

MONORAIL METHOD.—Dropping hide and sawing carcass with this method includes: Dropping hide, putting hide in chute, sterilizing knife, moving carcass, spreading, sawing carcass, and scribing.

The worker walks 10 feet from the sawing work area to the hide dropping area, skins the neck to remove the hide from the carcass, sterilizes his knife, and moves the carcass on the rail an average distance of 10 feet to the sawing area. He then manually spreads the hind legs of the carcass, using mechanical rail flap stops, steps up on a one-level work platform and saws the carcass into halves with a beef carcass saw. He descends the plat-

form, scribes each half carcass, and pushes them on the rail (average distance, 8 feet) to the rail inspection area.

See table 2 for figures as to requirements and costs. The equipment cost is based on the use of 200 trolleys and 14 feet of dressing rail for 6.56 machine-hours each; a beef carcass saw, a one-level platform, and a saw sterilizer, for 2.26 machine-hours each; and a sterilizing lavatory for 0.09 machine-hour.

Hydraulic lift method.—This method comprises: Dropping hide, putting hide in chute, sterilizing knife, moving carcass, sawing carcass, and scribing. A hydraulic lift platform raises the worker to a level with the hind quarters of the carcass and lowers him as he saws the carcass (fig. 5). A pneumatic spreader, actuated by the worker, spreads the hind legs of the carcass. The worker steps onto the hydraulic lift platform, raises it to the top level, spreads the carcass, saws while the platform is descending, releases the spreader, and steps from the platform to the floor. The other work is the same as by the monorail method.

See table 2 for figures as to requirements and costs. The equipment cost is based on 200 trolleys and 14 feet of dressing rail for 6.38 machine-hours each; a hydraulic lift platform, pneumatic spreader, saw sterilizer, and beef carcass saw, for 2.32 machine-hours each; a scribe saw for 0.52 machine-hour; and a sterilizing lavatory for 0.09 machine-hour.

Comparison of three methods.—The total cost by the monorail method is $1.32 less than the split rail method and $1.07 less than the hydraulic lift method (table 2).

The hydraulic lift method requires the highest equipment cost and the lowest labor cost. The main advantage to this method is that sawing carcasses is easier, hence a smaller fatigue factor is allowed. It is not necessary for the worker to bend over while sawing the lower half of the carcass.

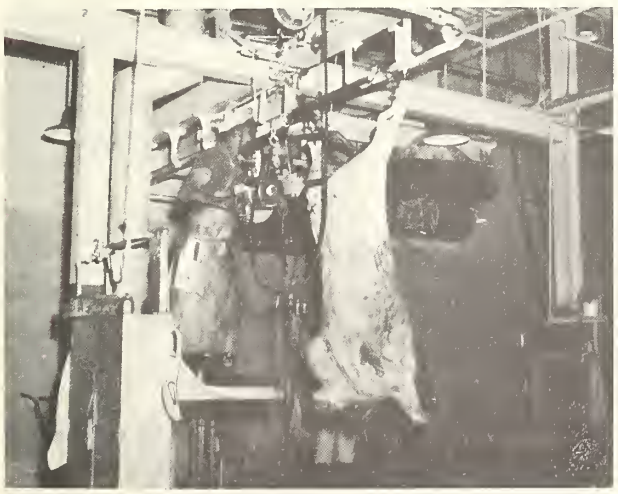

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Figure 5.—Sawing a carcass by the hydraulic platform method.

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Figure 6.—Washing a carcass side to remove blood, dirt, and bone dust. Carcasses in this plant are shrouded in the same area.

The split rail method involves the highest labor cost and lowest equipment cost. This method requires the work of splitting carcasses into halves to be done at two separate times, thereby necessitating a high labor requirement.

Washing

Washing is necessary to remove blood, bone dust, and dirt from each carcass (fig. 6). A minimum of four half carcasses are moved into the washing area at one time. Each half of a carcass (generally called a side) is washed with a high pressure spray of water by a worker standing on a work platform. Two methods are used, the split rail one-level platform and the monorail two-level platform.

Split rail one-level platform method.—The work platform used with this method is about 3 feet high, 2 feet wide, and 6 feet long. A dressing rail switch is used in assembling carcasses. One worker assembles four sides from the two dressing rails and moves them onto the single washrail in front of the one-level work platform (average distance of movement, 10 feet). The worker then ascends a platform, washes each of the four

sides, and descends to the floor. He moves the sides down the rail an average distance of 7 feet to the shrouding platform and walks about 15 feet to the scribing area for another four sides.

See table 2 for figures as to requirements and costs. The equipment cost is based on the use of 200 trolleys and 18 feet of dressing rail for 5.09 machine-hours each, a (1–R) dressing rail switch for 0.29 machine-hour, and a hydraulic cattle washer and a one-level work platform for 4.61 machine-hours each.

Monorail two-level platform method.—The two-level platform is 3 feet wide; the first level is 1½ feet high by 4 feet long, and the second level is 4½ feet high by 4 feet long. Two workers are involved in this method. One worker moves carcasses on the monorail, four sides at a time, from the rail inspection area to the washing area, a distance of 7 feet. The other worker, on a work platform, washes each side of the two carcasses. After carcasses are washed, they remain in the area for shrouding.

Table 2 gives the labor and equipment requirements and costs. The equipment cost is based on 200 trolleys, 11 feet of dressing rail, a hydraulic cattle washer, and a two-level work platform, for 4.25 machine-hours each.

Comparison of two methods.—The labor and equipment cost for washing by the monorail two-level platform method is less than by the split rail one-level platform method. The reduction is in the cost of labor. Less labor is required because the work of assembling sides from two rails is eliminated, walking to the scribe area is not necessary, moving carcasses to a shrouding area is not required, a shorter distance for moving carcasses to the washing area is provided, and less labor is required in the actual washing because the two-level platform allows the worker to stand closer to the portion of the carcass being washed.

Table 2 gives comparative figures as to requirements and costs by these two methods.

Shrouding

In shrouding sides of a carcass, a heavy muslin cloth is pinned to each side. The cloths are kept in a container on the work platform and are soaked in a brine solution at about 120° F. The cloth is first placed around the hind shank so that it overlaps on the inside of the shank. It is stretched tightly and pinned at intervals to completely cover the outside of each side. From 7 to 12 shroud pins are used on each side. The shroud remains on the carcass through the weighing operation and is removed after chilling. The shroud weighs about ten pounds when wet. Two methods are used, the one-level platform and the two-level platform.

One-level platform method.—This method includes: Set up, shroud, and move carcasses to the weighing area. One worker is used. To set up the work area, a container on the platform is filled with a supply of shrouds. The worker ascends the one-level platform, gets a shroud from the container, pins the shroud to the hindquarter of a side, descends to the floor, and pins the shroud to the forequarter. He then repeats this work on the other halves of the two carcasses held in the shrouding area. After shrouding, he manually moves the carcasses on the rail (two at a time) an average distance of 8 feet onto the track scale in the weighing area (fig. 7).

Table 2 gives the labor and equipment requirements and costs. The equipment cost is based on a one-level platform for 4.62 machine-hours, and 200 trolleys and 6 feet of dressing rail for 4.92 machine-hours each.

Two-level platform method.—The work performed with this method is the same as that with the one-level platform method. However, the two-level platform method requires two workers. One worker performs the setup work and shrouds each carcass side. He remains on the platform at all times to low- and high-shroud the carcass.

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Figure 7.—Moving two shrouded carcass sides from shrouding work station.

The other worker walks 10 feet to the carcasses (after they have been shrouded) and moves them on the rail an average distance of 10 feet onto the track scale in the weighing area.

Table 2 provides the labor and equipment requirements and costs. The equipment cost is based on 200 trolleys and 11 feet of dressing rail for 2.53 machine-hours each, and a two-level work platform for 2.19 machine-hours.

Comparison of two methods.—The cost for shrouding 100 carcasses by the two-level platform method is less than the cost for the one-level platform method (table 2). A slight reduction in equipment cost is shown by the two-level platform method; however, most of the reduction is in the cost of labor. The labor saving is possible because the two-level platform permits the worker to remain on the platform for shrouding, thereby

eliminating the time of ascending and descending the platform.

Weighing

The last line slaughtering operation is weighing. Both halves of a carcass are weighed at the same time in order to determine the weight of the carcass. The carcasses are pushed onto an overhead track scale, weighed, stamped, and moved into the chilling cooler. Two methods are discussed: The beam scale method; and the dial scale method. Each method requires one worker.

Beam scale method.—The operation of weighing by the beam scale method involves the following work, listed in the order of occurrence: Weigh; tag; stamp; move carcass; move 2 carcasses; open chill room door; move 2 carcasses; and walk. To weigh, the worker balances the scale beam, determines the weight, records it on a tally sheet and writes it on two tags for the carcass. He places a tag on each foreleg of the carcass and stamps both sides of the carcass with the company name. The work of moving carcasses includes pushing each carcass a short distance off the overhead track scale to clear it for the next carcass. When two carcasses have been weighed, tagged, and stamped, the worker moves them on the rail an average distance of 10 feet to the chilling cooler door, opens the door, and pushes them into the chilling cooler. The door is pulled shut (but not latched) behind him. The worker moves the two carcasses an average distance of 40 feet within the chilling cooler, and walks an average of 60 feet to return to the shrouding platform. This completes the weighing operation cycle.

Table 2 gives the labor and equipment requirements and costs. The equipment requirements are based on 200 trolleys and 19 feet of dressing rail for 3.00 machine-hours each, and a beam scale for 1.96 machine-hours.

Dial scale method.—The time items required for this method are the same as those required by the beam scale method with the exception of moving two carcasses to the chill room door. This item is eliminated by the dial scale method. The distances of movement are also different (table 14). With the dial scale method, the worker—in the walk time item—returns to the weighing area, instead of the shrouding area as shown with the beam scale method. Otherwise, the work is performed in the same manner.

See table 2 for figures as to requirements and costs. Equipment cost is based on 200 trolleys and 10 feet of dressing rail for 2.59 machine-hours each, and a dial track scale for 1.86 machine-hours.

Comparison of two methods.—A total cost reduction of 30 cents per 100 cattle is shown when the dial scale method is used. This reduction is largely due to the improved layout which provides for shorter distances of movement to allow less labor requirements. The beam scale method requires longer distances due to the use of two separate chilling coolers, as shown in the typical layout (fig. 16). A slight reduction in labor cost is also realized in the weighing time item through use of the dial track scale. This scale eliminates the need for balancing a beam and allows the worker to read the weight much easier. The equipment cost is $0.21 higher for the dial scale method, due primarily to the higher cost of the dial track scale.

See table 2 for comparative figures as to requirements and costs by these two methods.

Effect of Work Methods on Labor Requirements for Line Slaughtering Operations

The time required to perform the longest operation determines the pace for all operations. As previously shown, the elapsed times required for the various line slaughtering operations vary widely. Furthermore, the time required for a specific operation varies by the kind of work method used.

Most plants attempt to divide operations among workers so that the time required of each worker to perform an operation, or a goup of operations, is equal. However, in plants slaughtering 100 cattle daily, it is practically impossible to arrange operations among workers, regardless of the method used, so that the time required for each is exactly the same. As a result, job regulated wait time (unproductive labor), is an inherent characteristic of line slaughtering. Therefore, the total labor requirement for performing line operations is the total of productive and unproductive labor.

Table 3 shows the crew organization and productive and unproductive labor requirements for performing line operations with combination A and combination B methods in plants slaughtering 100 cattle daily of the typical weight group.

Labor requirements for line slaughtering operations with combination A methods.—Combination A methods are: Driving by the corner drive method; immobilizing by the rifle method; dumping by the sliding door method; dry landing by the nonautomatic lander method; bleeding and head skinning by the long rail method; flooring by the pritch plate method; rumping, backing, and eviscerating by the split rail method, using one worker; dropping hide and sawing carcass by the split rail method; washing by the split rail, one-level platform method; shrouding by the one-level platform method; and weighing by the beam scale method.

A typical crew for these operations in a plant slaughtering 100 cattle daily of the typical weight group is comprised of 7 workers. One worker is assigned to the first 5 operations of driving, immobilizing, dumping, dry landing, and bleeding and head skinning. Two workers perform the flooring operation; one worker rumps, backs, and eviscerates; one worker drops hides and saws carcasses; one worker washes; and one worker shrouds and weighs.

TABLE 3.—*Crew organization, productive and unproductive labor requirements per 100 cattle for line operations, by combination of methods, in plants slaughtering 100 cattle daily* [1]

Combination A methods [2]					Combination B methods [3]				
Operation	Crew size [4]	Productive labor	Job regulated wait time [5]	Total labor	Operation	Crew size [6]	Productive labor	Job regulated wait time [5]	Total labor
	Number	*Man-hours*	*Man-hours*	*Man-hours*		*Number*	*Man-hours*	*Man-hours*	*Man-hours*
Driving (1.77 hrs.), Immobilizing (0.59 hrs.), Dumping (0.18 hrs.), Dry landing (1.96 hrs.), Bleeding and head skinning (4.27 hrs.)	1	8.77	2.46	11.23	Driving (1.51 hrs.), Immobilizing (0.59 hrs.), Dumping (0.09 hrs.), Dry landing (1.50 hrs.), Bleeding and head skinning (4.07 hrs.)	1	7.76	0.20	7.96
Flooring	2	15.14	7.32	22.46	Flooring	2	12.96	[7] 2.83	[7] 15.79
Rumping, backing, and eviscerating	1	11.23	0	11.23	Rumping, backing, and eviscerating	2	[8] 9.88	0	9.88
Dropping hide and sawing carcass	1	7.35	3.88	11.23	Dropping hide and sawing carcass	1	6.56	[9] 1.30	[9] 7.86
Washing	1	5.09	6.14	11.23	Washing (4.35 hrs.), Shrouding (2.53 hrs.)	1	[10] 6.88	1.18	[10] 8.06
Shrouding (4.92 hrs.), Weighing (3.00 hrs.)	1	7.92	3.31	11.23	Weighing	1	2.59	5.37	7.96
Total	7	55.50	23.11	78.61	Total	8	46.63	10.88	57.51
Elapsed hours	11.23				Elapsed hours	7.96			

[1] Based on 50 percent weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weight).

[2] Combination A methods: Driving by corner drive; immobilizing by rifle; dumping by sliding door; dry landing by nonautomatic method; bleeding and head skinning by long rail; flooring by pritch plate; rumping, backing, and eviscerating by split rail; dropping hide and sawing carcass by split rail; washing by split rail one-level platform; shrouding by one-level platform; and weighing by beam scale.

[3] Combination B methods: Driving by straight drive; immobilizing by rifle; dumping by revolving door; dry landing by automatic method; bleeding and head skinning by short rail; flooring by cradle; rumping, backing, and eviscerating by monorail; dropping hide and sawing carcass by monorail; washing by monorail two-level platform; shrouding by two-level platform; and weighing by dial scale.

[4] Typical crew in plants studied.

[5] Unproductive labor caused by irregular flow of work between operations.

[6] Proposed crew.

[7] Excludes 0.13 man-hour 1 worker devotes to rumping, backing, and eviscerating.

[8] One worker, 7.96 man-hours; 1 worker, 0.13 man-hours; and 1 worker, 1.79 man-hours.

[9] Excludes 0.10 man-hour worker devotes to washing operation.

[10] Includes 0.10 man-hour the worker dropping hide and sawing carcass devotes to the operation.

Rumping, backing, and eviscerating require more time than other operations along the line. As a result, a job regulated wait time accrues to all workers in the line except the worker performing the rumping, backing, and eviscerating.

Approximately 29 percent of the total labor requirement is unproductive labor and is due to the uneven flow of work.

Labor requirements for line slaughtering operations with combination B methods.—Combination B methods are: Driving by the straight drive method; immobilizing by the rifle method; dumping by the revolving door method; dry landing by the automatic lander method; bleeding and head skinning by the short rail method; flooring by the cradle method; rumping, backing, and eviscerating by the monorail method; dropping hide and sawing carcass by the monorail method; washing by the monorail, two-level platform method; shrouding by the two-level platform method; and weighing by the dial scale method.

The proposed new organization for line slaughtering operations with combination B in a plant slaughtering 100 cattle daily requires 8 workers. One worker is assigned to the first 5 operations of driving, immobolizing, dumping, dry landing, and bleeding and head skinning. Two workers are assigned to the flooring operation; however, one of the workers devotes 0.13 hour of his time to the rumping, backing and eviscerating operation. Two other workers are assigned to the rumping, backing and eviscerating operation; one of these workers devotes full time to the operation but the other assists for only 1.79 hours. One worker is assigned to dropping hide and sawing carcass; one, to washing and shrouding; and one, to weighing.

The time required to perform the rumping, backing, and eviscerating operation is 7.96 hours. This time is greater than that required by any other worker or workers to perform the operation or group of operations to which they are assigned. Therefore, job regulated wait time accrues to all workers except those performing the rumping, backing, and eviscerating operation.

Unproductive labor amounts to about 19 percent of the total labor requirements.

Comparison of labor requirements for line slaughtering operations by combination A and combination B methods.—Productive labor requirements for performing line operations with combination B are 8.87 man-hours less than with combination A, a reduction of about 16 percent. Unproductive labor is reduced 12.23 man-hours, or about 53 percent, with combination B.

The reduction in the amount of productive labor with combination A is due to improved work methods and an improved layout. The reduction in the amount of unproductive labor with combination B is due to improved work methods and a plant layout which allows operations to be performed with a shorter elapsed time and to be divided so that the time required of each worker to perform an operation or group of operations is more nearly equal.

Summary of Requirements for Line Slaughtering Operations

The reduction in cost with combination B amounts to $35.57 and all of the reduction is in the labor cost. The equipment cost with combination B is slightly higher (table 4).

Some saving in labor is incurred in all line slaughtering operations, except the immobilizing operation, with combination B. The method of immobilizing is the same by each method. The largest labor saving is incurred in the flooring operation and is largely the result of using the cradle which permits better crew organization and more efficient performance. The reduction in the labor requirement for rumping, backing, and eviscerating is the result of using three workers. The reduction in the labor requirement for washing and shrouding is primarily the result of using a two-level platform. The revolving door reduces the labor requirements for dumping. Improved equipment, such as the automatic lander and the dial type scale, lowers the labor requirements in the dry landing and weighing operations. The lower labor requirement in the driving, bleeding and head skinning, and dropping hides and sawing carcass operations is due primarily to an improved layout which provides shorter walking distances for workers and shorter distances for moving cattle and carcasses between work stations. An improved layout reduces the labor requirements, to some extent, for practically all operations.

The job regulated wait time and unproductive labor requirements are reduced with combination B, because the elapsed time for performing most operations is smaller and less wait time accrues between operations or groups of operations. Furthermore, the methods, equipment, and layout used with combination B permit the work to be divided so that the time required of each worker to perform an operation or a group of operations is more nearly equal. Unproductive labor inherent in line slaughtering operations is reduced 12.23 man-hours with combination B.

Killing Floor Supporting Operations

The operations performed by workers on the killing floor in direct support of the line slaughtering operations are: (1) Head workup; (2) removing legs from the killing floor; (3) removing viscera from the killing floor; and (4) removing head bones from the killing floor. These operations are not performed in sequence as are the line slaughtering operations. With the exception of removing head bones, which depends upon head workup for a supply of head bones, they are performed independently of one another and are dependent upon the line slaughtering operations which supplies the offal handled.

TABLE 4.—*Summary of labor and equipment requirements per 100 cattle for killing floor line slaughtering operations and for killing floor supporting operations in plants slaughtering 100 cattle daily by combination of methods* [1]

Operation	Combination A methods					Combination B methods				
	Labor and equipment requirements		Labor and equipment costs			Labor and equipment requirements		Labor and equipment costs		
	Labor	Equipment	Labor	Equipment	Total	Labor	Equipment	Labor	Equipment	Total
	Man-hours	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*	*Man-hours*	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*
Line slaughtering operation: [2]										
Driving	1. 77	0	2. 83	0	2. 83	1. 51	0	2. 42	0	2. 42
Immobilizing	. 59	. 59	. 94	. 08	1. 02	. 59	. 59	. 94	. 08	1. 02
Dumping	. 18	. 22	. 29	. 35	. 64	. 09	. 02	. 14	. 32	. 46
Dry landing	1. 96	5. 67	3. 14	. 73	3. 87	1. 50	5. 76	2. 40	1. 00	3. 40
Bleeding and head skinning	4. 27	12. 41	6. 83	. 27	7. 10	4. 07	11. 93	6. 51	. 26	6. 77
Flooring	15. 14	38. 97	30. 28	. 70	30. 98	12. 96	34. 20	25. 92	. 72	26. 64
Rumping, backing, and eviscerating	11. 23	33. 87	22. 46	. 85	23. 31	9. 88	23. 97	18. 42	. 85	19. 27
Dropping hide and sawing carcass	7. 35	21. 55	11. 76	2. 07	13. 83	6. 56	20. 51	10. 50	2. 01	12. 51
Washing	5. 09	19. 69	6. 36	1. 83	8. 19	4. 35	17. 00	5. 44	1. 88	7. 32
Shrouding	4. 92	14. 46	6. 15	. 13	6. 28	2. 53	7. 25	3. 16	. 09	3. 25
Weighing	3. 00	7. 96	3. 75	. 39	4. 14	2. 59	7. 04	3. 24	. 60	3. 84
Subtotal	55. 50	155. 39	94. 79	7. 40	102. 19	46. 63	128. 27	79. 09	7. 81	86. 90
Unproductive labor [3]	23. 11	0	36. 60	0	36. 60	10. 88	0	16. 32	0	16. 32
Total	78. 61	155. 39	131. 39	7. 40	138. 79	57. 51	128. 27	95. 41	7. 81	103. 22
Supporting operation: [4]										
Head workup	8. 49	16. 27	13. 58	. 62	14. 20	7. 86	31. 53	12. 58	. 62	13. 20
Removing legs from the killing floor	. 08	. 08	. 10	. 02	. 12	0	0	0	0	0
Removing viscera from the killing floor	2. 62	5. 24	3. 28	. 19	3. 47	1. 81	3. 62	2. 26	. 19	2. 45
Removing head bones from the killing floor	. 07	. 07	. 09	. 02	. 11	0	0	0	0	0
Total	11. 26	21. 66	17. 05	. 85	17. 90	9. 67	35. 15	14. 84	. 81	15. 65
Grand total	89. 87	177. 05	148. 44	8. 25	156. 69	67. 18	163. 42	110. 25	8. 62	118. 87

[1] Based on 50 percent of the animals weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 precent from 600 to 900 pounds (dressed weight).

[2] Combination A methods: Driving by corner drive method; immobilizing with the rifle, dumping with the sliding door; dry landing with the nonautomatic lander; bleeding and head skinning with the long rail; flooring with the pritch plates; rumping, backing, and eviscerating with the split rail; dropping hide and sawing carcass with the split rail; washing with the split rail one-level platform; and weighing with the beam scale. Combination B methods: Driving by straight drive method; immobilizing with the rifle; dumping with the revolving door; dry landing with the automatic lander; bleeding and head skinning with the short rail; flooring with the cradle; rumping, backing and eviscerating with the monorail; dropping hide and sawing carcass with the monorail; washing with the monorail two-level platform; shrouding with the two-level platform; and weighing with the dial scale.

[3] Unproductive labor caused by irregular flow of work between operations.

[4] Combination A methods: Head workup by the two work station method; removing legs from the killing floor by the barrel method; removing viscera from the killing floor by the long transport method; removing head bones from the killing floor by the barrel method. Combination B methods: Head workup by the one work station method; removing legs from the killing floor by the gravity chute method; removing viscera from the killing floor by the short transport method; and removing head bones from the killing floor by the gravity chute method.

Head Workup

Head workup involves flushing and dehorning heads, dropping tongues, and trimming heads. Heads are removed from carcasses in the line-slaughtering operation of bleeding and head skinning, and transported to the head workup area. It is important that heads be removed from carcasses at the same speed with which the bleeding and head skinning operation is performed to prevent delays in this and other line operations. Two methods are used for the head workup operation, the two work station and the one work station. Equipment arrangement is the influencing factor with both methods.

TWO WORK STATION METHOD.—Two work areas, 20 feet apart, are used in this method. A head flush cabinet and a head inspection rack are in one area (fig. 8). Here, heads are flushed and dehorned, tongues are dropped; and heads are inspected on the inspection rack. A head workup

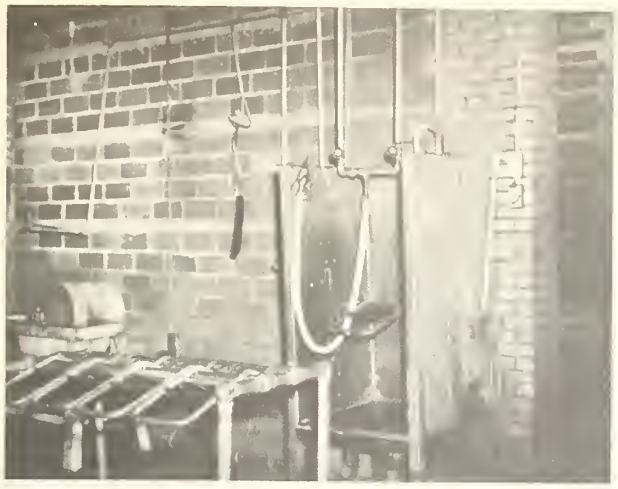

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FIGURE 8.—Head flushing station showing head flush cabinet and head inspection rack.

table, where heads are trimmed, is in the other area.

Two workers perform the head workup operation. One worker stands at the head flush cabinet and head inspection rack. He walks from the inspection rack to the bleeding pit, an average distance of 20 feet, removes a head from a carcass and manually transports it to the head flush cabinet. He flushes the head, removes the horns, and manually carries it to the head inspection rack, an average distance of 7 feet. After an average of 4 heads have been assembled on the rack, the worker drops the tongues. Dropping tongues involves cutting the hyoid bones, removing tonsils, loosening tongues to hang by forejaw, and washing heads. The worker sterilizes his knife and washes his hands.

The second worker, who trims the heads, is located at the head workup table. He sets up the work station by assembling offal containers and a supply of ice. He manually transports heads, two at a time, from the head inspection rack to the head workup table, then trims them. Trimming heads involves removing the head and cheekmeat, lips, separating the jaws, and throwing head bones into barrels. This worker also sterilizes his knives and washes his hands during the cycle of work.

See table 5 for breakdown of cost and requirements. The equipment cost is based on a head flush cabinet, hand meat saw, and head inspection rack for 3.82 machine-hours each; a head workup table for 4.67 machine-hours; and a sterilizing lavatory for 0.14 machine-hour.

ONE WORK STATION METHOD.—Only one area is used for this method. The head flush cabinet, head inspection rack, and head workup table are compactly arranged in the area. One worker performs the operation. After assembling offal containers and a supply of ice at the head workup table, the worker walks to the bleeding pit, an average distance of 5 feet, removes a head from a carcass and manually transports it a distance of 5 feet to the head flush cabinet where he flushes and dehorns it. He then manually carries the head to the head inspection rack, a distance of 5 feet, and places it on the rack. When 4 heads are assembled on the rack he drops the tongues. After inspection of the heads, he manually transports them, 2 at a time, to the head workup table, a distance of 7 feet, and trims them. He sterilizes his knives and washes his hands during the cycle of work.

See table 5 for the labor and equipment requirements and costs. The equipment cost is based on a head flush cabinet, head meat saw, head inspection rack, and a head workup table, for 7.86 machine-hours each, and a sterilizing lavatory for 0.09 machine-hour.

COMPARISON OF TWO METHODS.—The two work station method incurs a total labor and equipment cost of $14.20, as compared with $13.20 for the one work station method (table 5). The equipment cost is the same for both methods; therefore, the $1.00 reduction per 100 cattle is in the cost of labor. A reduction in labor cost is possible with the one work station method because less labor is required for transporting heads during the work cycle.

TABLE 5.—*Labor and equipment requirements and costs per 100 cattle for head workup and for removing viscera, each by two methods in plants slaughtering 100 cattle daily* [1]

Operation and method	Elapsed time	Labor and equipment requirements		Labor and equipment costs		
		Labor	Equipment	Labor	Equipment	Total
	Hours	*Man-hours*	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*
Head workup:						
Two work station	4. 67	8. 49	16. 27	13. 58	0. 62	14. 20
One work station	7. 86	7. 86	31. 53	12. 58	. 62	13. 20
Removing viscera:						
Long transport	2. 62	2. 62	5. 24	3. 28	. 19	3. 47
Short transport	1. 81	1. 81	3. 62	2. 26	. 19	2. 45

[1] Based on 50 percent of the animals weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weight).

Removing Legs From the Killing Floor

Legs are removed from carcasses in the flooring line slaughtering operation. The legs are removed from the killing floor during the slaughtering period in order to keep the floor clean, prevent it from becoming clogged with barrels, and keep aisle space open for workers. Two methods are used in removing legs from the killing floor, the barrel and the gravity chute.

Barrel method.—The workers who perform the flooring operation remove the legs from the carcass and throw them into a 55-gallon barrel. On an average, 4 barrels are filled during the slaughter of 100 cattle of the typical weight group.

When a barrel is filled with legs it is removed from the killing floor. (Since the barrels are removed periodically, the worker who does this job also handles other assignments.) The worker attaches a barrel truck to a filled barrel, transports it an average distance of 65 feet to the dock, detaches it, attaches the truck to an empty barrel on the dock, and transports it back to the flooring work station as a replacement. The elapsed time required for removing the legs of 100 cattle of the typical weight group from the killing floor is 0.08 hour. The elapsed time does not include the time the worker takes to throw the legs into the barrels; this time is included in the elapsed time for the flooring operation.

The labor requirement is 0.08 man-hour and the labor cost is 10 cents. The equipment cost is 2 cents, based on the use of a 2-wheel barrel truck for 0.08 machine-hour. The total labor and equipment cost is 12 cents.

Gravity chute method.—In this method the workers at the flooring work station throw the legs into a nearby chute as they cut them from the carcass. The legs drop through the chute and into a container on the dock of the hide cellar. Thus, legs are removed from the killing floor by the workers who perform the flooring operation. The time required for throwing the legs into the chute is included with the time requirements for the flooring operation, and the chute is considered a part of the facility. Therefore, no labor or equipment costs are incurred.

Comparison of two methods.—The labor and equipment cost for removing legs from 100 carcasses of the typical weight group from the killing floor by the barrel method is 12 cents. No costs are incurred with the gravity chute method. Therefore, the savings with the gravity chute method amounts to 12 cents.

Removing Viscera From the Killing Floor

Viscera is removed in a paunch truck from the rumping, backing, and eviscerating area on the killing floor to the viscera washing and separating room. Two methods are used, the long transport and the short transport. One worker performs the operation with each method.

Long transport method.—This method involves: Transporting a paunch truck with viscera from the truck holding area near the eviscerating work station to the pluck table, placing the pluck on the table, transporting the truck from the pluck table to paunch table in viscera washing and separating room, dumping the paunch on a paunch lift and placing remaining viscera in a barrel, transporting the truck to the rinsing area, and rinsing and transporting truck to holding area at the eviscerating work station. The worker transports the truck a distance of 75 feet and walks an additional 70 feet between his work station and the truck holding area.

Table 5 gives the labor and equipment requirements and costs. The equipment cost is based on 2 paunch trucks for 2.62 machine-hours each.

Short transport method.—The worker transports the paunch truck from under the carcass brisket to the pluck table, places the pluck on the table, transports the truck from pluck table to the paunch table, dumps the paunch on the paunch lift and places the remaining viscera in a barrel, transports the truck to rinse area and rinses, and transports truck to eviscerating work station and positions it under the brisket. The total transport distance is 60 feet. The elapsed time required to remove the viscera of 100 cattle of the typical weight group is 1.81 hours.

See table 5 as to figures on requirements and costs. The equipment cost is based on 2 paunch trucks for 1.81 machine-hours each.

Comparison of two methods.—The total cost by the long transport method is $3.47, as compared with $2.45 for the short transport method (table 5). The $1.02 reduction per 100 cattle is due to the improved layout, which reduces the transport distances and, in turn, the labor requirements.

Removing Head Bones From the Killing Floor

The two methods for removing head bones are the same as for removing legs, the barrel and gravity chute.

Barrel method.—Head bones are thrown into 55-gallon drums (by the head trimmer) for storage until they are removed. The head bones of 100 cattle of the typical weight group will fill an average of 6 barrels. These barrels are removed intermittently during the slaughtering cycle. The work involved is: Attaching barrel truck to barrel, transporting it 35 feet to the dock, and returning empty barrel as replacement. The elapsed time is 0.07 hour.

The labor requirement is 0.07 man-hour and the labor cost is 9 cents. The equipment cost of 2 cents is based on a 2-wheel barrel truck for 0.07 machine-hour. Barrels are not charged to equipment cost. The total cost is $0.11.

Gravity chute method.—Head bones are dropped by the head trimmer into a chute to the hide cellar dock. No labor is required since the transporting is done by gravity. The chute is considered a part of the facility; therefore, no costs are involved.

Comparison of two methods.—A reduction in cost of 11 cents per 100 cattle of the typical weight group occurs through the use of the gravity chute method.

Summary of Requirements for Supporting Operations

The labor and equipment cost for performing killing floor supporting operations by combination A methods is $17.90 per 100 cattle as compared to $15.65 for combination B (table 4). The $2.25 reduction is largely due to an improved work area layout in the head workup operation and improved work methods for removing viscera from the killing floor. These factors decrease the labor requirements for the supporting operations by 14 percent over combination A methods. Improved handling methods, made possible by the use of gravity flow for removing legs and head bones from the killing floor, eliminates the labor and equipment required by combination A.

Summary of Requirements for Killing Floor Operations

The total costs per 100 cattle for performing killing floor operations for plants slaughtering 100 cattle daily with 50 percent of the animals weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weights) is $156.69 with combination A methods, as compared with $118.87 with combination B (table 4). The labor and equipment requirements with combination A are 89.87 man-hours and 177.05 machine-hours, as compared with 67.18 man-hours and 163.42 machine-hours with combination B. The reduction in cost with combination B amounts to $37.82 or 38 cents per head of cattle. Labor requirements are reduced about 0.23 man-hour per head with combination B. Although the equipment requirements are less with combination B, equipment costs are slightly higher because of the higher cost of the equipment used with the improved work methods. With each combination of methods, the equipment cost accounts for less than 10 percent of the total cost.

The reduction in costs with combination B is due to the use of labor saving equipment in several operations, an improved plant layout which permits an arrangement of work stations that minimizes the distances workers walk between stations and the distances for moving carcasses and by-products between stations, and improved work methods which allow operations to be divided more equally among workers thereby reducing the amount of unproductive labor inherent in line slaughtering operations.

The total cost for performing line slaughtering operations with combination A methods is $138.79 as compared with $103.22 with combination B. The reduction of $35.57 is due to less labor cost. The equipment costs are slightly higher with combination B methods. About 44 percent of the total labor saving is in productive labor, and 56 percent is in unproductive labor inherent to line slaughtering operations.

The total cost for performing killing floor supporting operations with combination A methods is $17.90, as compared with $15.65 with combination B. Most of the reduction is in the cost of labor; however, a slight reduction in equipment cost also is incurred.

Hide Room Storing Operation

Hides are removed from the killing floor as required during slaughtering operations. They are transported to a hide room which may be a separate building adjacent to or near the plant proper, or a cellar beneath the killing floor. Both places serve for storing, curing, and loading out hides. The hide house or cellar, in plants slaughtering 100 cattle daily, normally contains two vats for storing and curing hides, a storage area for salt, and a working area for receiving and shipping hides. The hide room is usually kept cool (generally recommended temperatures not above 55° F.) and dark. Usually, hides are loaded out on an average of 12 times a year. Labor and equipment requirements for loading out hides are not discussed in this analysis.

Storing hides consists in removing hides from the killing floor, spreading them in vats, and salting them as they are stacked to a height of about 4 feet. The hides generally are left a minimum of 30 days to cure before shipping. Approximately 1 cubic foot is required per hide for storing and curing.

Two methods of storing hides are employed: The barrel and hide house method; and the gravity chute and hide cellar method. One worker is required by each method.

Barrel and hide house method.—This method includes: transporting 55-gallon barrels filled with hides from the hide dropping area on the killing floor to the hide house (an average distance of 75 feet), emptying barrels onto hide house floor, placing hide on a work table and trimming, spreading hide (hair down) in vat, and shoveling salt over hide. Eight barrels of hides per 100 cattle of the typical weight group are handled. The elapsed time required to store 100 hides is 3.36 hours and the labor requirements follow as 3.36 man-hours.

The cost of labor is $4.20 per 100 cattle. The equipment cost is 4 cents, based on the use of a 2-wheel barrel truck for 0.22 machine-hour. Total labor and equipment cost is $4.24.

Gravity chute and hide cellar method.—Hides are dropped via a gravity chute directly into the hide cellar and onto a wooden platform located in front of the two curing vats. (This arrangement eliminates the work of transporting hides, emptying barrels, and placing hides on a work table.) The hides are then trimmed and spread (hair down) in one of the vats, and salt is

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shoveled over each. The elapsed time is 2.47 hours.

The labor requirements are 2.47 man-hours and the labor cost is $3.09. Since no equipment cost is involved, the total cost of the operation is also $3.09.

Comparison of two methods.—A reduction in cost of $1.15 per 100 cattle is incurred with the gravity chute and hide cellar method. Of this amount, $1.11 occurs in the cost of labor, due to the elimination of the transport time and the use of improved work methods. Since a barrel truck is not needed with the method, a 4-cent reduction in equipment cost is incurred.

Viscera Washing and Separating Room Operations

Three major operations are performed in the viscera washing and separating room, which is usually located in an area adjacent to the killing floor. The operations are separating plucks, emptying paunches, and cleaning tripe. As previously stated, it is assumed that tripe, hearts, livers, and tails will be processed for sale and that lungs, trachea, and the remaining viscera will be rendered. The separating-plucks work, even though performed in an area other than the viscera washing and separating room, is considered an operation of this department.

Separating Plucks

The pluck includes the heart, lungs, and trachea of cattle. These items are separated, washed, and placed in storage containers. The tails and livers, processed with the pluck, are washed and placed in storage containers at the separating-pluck work station. Two methods used in separating plucks are the combined work station and the separate work station. One worker performs the operation by each method.

Combined work station method.—The pluck trimming table is located next to the head trimming table. A worker, using a hand knife, separates the hearts from the lungs and trachea. The hearts are thrown into a 500-pound tub truck containing ice (periodically supplied by the worker) and the remainder of the pluck is thrown into 55-gallon barrels which are later sent to the rendering plant. Livers are washed and hung on individual hooks on an offal hanging truck. Tails are washed and placed in stainless steel pans.

See table 6 for the labor requirements and costs. The equipment cost is based on a pluck trimming table for 2.53 machine-hours.

Separate work station method.—This method includes the work of separating the hearts from the lungs and trachea, hanging hearts and livers on an offal hanging truck, and putting lungs and trachea in 55-gallon barrels. Tails are washed and placed in pans until they are transported to the offal chilling cooler. The worker also removes viscera from the killing floor.

Table 6 gives labor and equipment requirements and costs. Equipment cost is based on a pluck trimming table for 2.37 machine-hours.

Comparison of two methods.—The cost for separating plucks of 100 cattle by the combined work station method is $3.37 (table 6). The separate work station method permits a reduction of 20 cents per 100 cattle, owing to the elimination of the work in icing hearts in a tub truck.

Emptying Paunches

Emptying paunches includes removal of the stomach contents. The operation is performed on a stainless steel table top. Also needed are a working platform, a hopper for dumping stomach contents, and a paunch lift for hoisting and dumping paunches onto the table top. Two methods are the slow lift and fast lift methods; one worker performs the operation by each method.

Slow lift method.—The worker first ascends the working platform, raises the paunch lift (17 feet per minute) and dumps the paunch onto the table. He then lowers the paunch lift to the floor level. The paunch is opened with a hand knife and the

Table 6.—*Labor and equipment requirements and costs for separating plucks, emptying paunches, and cleaning tripe of 100 cattle, by specified methods in plants slaughtering 100 cattle daily* [1]

Operation and method	Elapsed time	Labor and equipment requirements		Labor and equipment costs		
		Labor	Equipment	Labor	Equipment	Total
	Hours	*Man-hours*	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*
Separating plucks:						
Combined work station	2. 53	2. 53	2. 53	3. 16	0. 21	3. 37
Separate work station	2. 37	2. 37	2. 37	2. 96	. 21	3. 17
Emptying paunches:						
Slow lift	3. 09	3. 09	4. 27	3. 86	1. 51	5. 37
Fast lift	2. 61	2. 61	3. 31	3. 26	1. 51	4. 77
Cleaning tripe:						
Long transport	2. 40	2. 40	2. 07	3. 00	1. 46	4. 46
Short transport	2. 29	2. 29	2. 07	2. 86	1. 46	4. 32

[1] Based on 50 percent of the animals weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weight).

contents washed into the hopper. The tripe is then placed on the umbrella type washer for further cleaning. The elapsed time for emptying paunches of 100 cattle is 3.09 hours.

See table 6 for labor and equipment requirements and costs. The equipment cost is based on a cattle paunch table for 3.09 machine-hours and a paunch lift hoist for 1.18 machine-hours.

Fast lift method.—The fast lift method of emptying paunches uses a hoist for dumping paunches with a lifting speed of 34 feet per minute or twice the speed by the slow lift method. This allows the operation to be done in 2.61 hours of elapsed time.

Table 6 gives the labor and equipment requirements and costs. The equipment cost is based on a cattle paunch table for 2.61 machine-hours and a paunch lift hoist for 0.70 machine-hour.

Comparison of two methods.—The fast lift method requires 60 cents less labor cost due to the shorter elapsed time permitted by the fast hoist. The equipment cost for both methods is the same (table 6).

Cleaning Tripe

The tripe is scraped and washed on an umbrella type washer prior to scalding. Cleaning tripe also includes transporting barrels of inedible offal to the dock. The two methods are the long transport and short transport. One worker is required by each method.

Long transport method.—A worker spreads the tripe over an umbrella washer and scrapes it with a hand scraper. The tripe is sprayed from an overhead water sprinkler. After each tripe is scraped and washed, the worker hangs it on a hook rack. When about 12 tripes are assembled on the rack, he manually transports them an average distance of 30 feet and places them in a scalder. After they are scalded, he places them in a tub truck. Intermittently during the operation the worker rolls an average of seventeen 55-gallon barrels of inedible offal from the viscera washing and separating room onto the dock, an average distance of 30 feet.

Table 6 gives labor and equipment requirements and costs. The equipment cost is based on an umbrella tripe washer for 1.67 machine-hours and a tripe scalder for 0.40 machine-hour.

Short transport method.—Cleaning tripe is performed in the same manner with the short transport method as with the long. With the short method, the average distance from the hook rack to the scalder is 20 feet. The average distance for rolling the 55-gallon barrels of inedible offal from the viscera wash and separating room to the dock also is 20 feet.

See table 6 for breakdown of requirements and costs. The equipment cost is based on an umbrella washer for 1.67 machine-hours and a tripe scalder for 0.40 machine-hour.

Comparison of two methods.—The total labor and equipment cost for the long transport method is $4.46, as compared with $4.32 with the short method (table 6). The 14 cents reduction is due to shorter transport distances.

Summary of Requirements for Viscera Washing and Separating Room Operations

The labor and equipment requirements for performing viscera washing and separating room operations for 100 cattle of the typical weight group by combination A and combination B methods are shown in table 7.

Combination A methods are: Separating plucks by the combined work station method, emptying paunches by the slow lift method, and cleaning tripe by the long transport method. Combination B methods are: Separating plucks by the separate work station method, emptying paunches by the

Table 7.—*Summary of labor and equipment requirements and costs per 100 cattle for performing viscera washing and separating room operations in plants slaughtering 100 cattle daily of the typical weight group, by combination of methods* [1]

Operation	Combination A methods [2]					Combination B methods [3]				
	Labor and equipment requirements		Labor and equipment costs			Labor and equipment requirements		Labor and equipment costs		
	Labor	Equipment	Labor	Equipment	Total	Labor	Equipment	Labor	Equipment	Total
	Man-hours	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*	*Man-hours*	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*
Separating pluck	2. 53	2. 53	3. 16	0. 21	3. 37	2. 37	2. 37	2. 96	0. 21	3. 17
Emptying paunches	3. 09	4. 27	3. 86	1. 51	5. 37	2. 61	3. 31	3. 26	1. 51	4. 77
Cleaning tripe	2. 40	2. 07	3. 00	1. 46	4. 46	2. 29	2. 07	2. 86	1. 46	4. 32
Total	8. 02	8. 87	10. 02	3. 18	13. 20	7. 27	7. 75	9. 08	3. 18	12. 26

[1] Based on 50 percent of the animals weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weight).

[2] Separating pluck by the combined work station method, emptying paunches by the slow lift method, and cleaning tripe by the long transport method.

[3] Separating pluck by the separate work station method, emptying paunches by the fast lift method, and cleaning tripe by the short transport method.

fast lift method, and cleaning tripe by the short transport method.

A total cost reduction of 94 cents per 100 cattle of the typical weight group is shown by combination B when compared with combination A. All of this reduction is due to labor cost. The improved layout (fig. 17), which allows shorter distances of travel for equipment and workers, permits the labor requirements to be decreased. The equipment cost is the same for both methods.

Chilling and Holding Cooler Operations

Chilling and holding coolers are used for storing carcass sides (fig. 9). The sides are supported by hooks suspended from one-wheel trolleys running on overhead rails. Carcasses are generally held overnight in the chilling cooler at temperatures of from 30° to 32° F. to remove initial body heat. From the chill coolers, carcasses are moved into the holding cooler, where they are held at a temperature of from 32° to 34° F. until sold.

The operations performed in the chilling and holding coolers are: Removing shrouds, transporting carcasses from the chilling cooler to the holding cooler, and order assembly. Moving carcasses from the weighing area on the killing floor into the chilling cooler is considered a time item of the killing floor weighing operation and not a chilling and holding cooler operation. The initial and operating cost of refrigeration equipment are not included in the equipment costs in the following discussion.

Removing Shrouds

Removing shrouds involves removing the shrouds from the sides after carcasses have been chilled and moving the shrouds from the chill cooler to the load-out dock. Two methods are used, the manual and the tub truck. One worker performs the operation by each method.

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FIGURE 9.—Chilling cooler partially filled with carcasses. Carcass retaining cage shown at right.

MANUAL METHOD.—A worker pulls the pins holding shrouds to the sides of carcasses and allows the shrouds to drop to the floor of the chill cooler. He then picks up the shrouds and manually transports them 70 feet to the loadout dock. Five trips are required to transport the shrouds from 100 carcasses from the chill room to the loadout dock. The elapsed time is 1.36 man-hours.

The labor requirements per 100 cattle are 1 36 man-hours and the labor cost is $1.70. The equipment cost is 35 cents, based on the use of 600 trolleys, 252 feet of dressing rail, and 14 1–L and 1–R switches, for 1.36 machine-hours each, for a total of 4.08 machine-hours. The total labor and equipment cost per 100 cattle is $2.05.

TUB TRUCK METHOD.—Shrouds are removed from sides of carcasses with the tub truck method in the same manner as in the manual method. However, with this method shrouds are transported from the floor of the chill cooler to the loadout dock in a 500-pound-capacity tub truck. The worker collects the shrouds from the chill cooler floor, places them in the tub truck, and transports the tub truck 50 feet to the loadout dock. Only one trip is required to transport the shrouds for the 100 carcasses. The elapsed time required is 1.25 hours.

The labor requirements per 100 cattle are 1.25 man-hours and the labor cost is $1.56. The equipment cost is 38 cents based on the use of 600 trolleys, 282 feet of dressing rail, and 14 1–R dressing rail switches, for 1.25 machine-hours each, for a total of 3.75 machine-hours. The total cost per 100 cattle is $1.94.

COMPARISON OF TWO METHODS.—The total labor and equipment cost per 100 cattle for removing shrouds from carcasses and transporting them from the floor of the chill cooler to the load-out dock by the manual method is $2.05, as compared with $1.94 by the tub truck method (table 8). The 11-cent reduction is in labor saved by the improved layout, which reduces the transport distance 20 feet, and the use of a tub truck which reduces the number of trips required.

Transporting Carcasses from the Chilling Cooler to the Holding Cooler

Carcasses are moved from the chilling cooler, after the body heat is removed, to the holding cooler where they are held until they are sold. Two methods are used, the short transport and the long transport. The short transport method is based on the distances involved in the typical layout and the long is based on distances in the proposed layout. One worker performs the operation with each method.

SHORT TRANSPORT METHOD.—Two carcasses (four sides) are moved simultaneously on the overhead rail an average distance of 43 feet. The worker pushes the carcasses on the rail from

the chill cooler to the holding cooler and returns to the chill cooler. The elapsed time required per 100 cattle is 0.61 hour.

The labor requirement is 0.61 man-hour and the labor cost is 76 cents. The equipment cost is 10 cents based on 600 trolleys, 213 feet of dressing rail, 7 1–L and 1–R dressing rail switches, and 1 three-way dressing rail switch, for 0.61 machine-hour each, for a total of 2.44 machine-hours. The total labor and equipment cost per 100 cattle is 86 cents.

Long transport method.—Carcasses are moved with the long transport method in the same manner as with the short transport method. However, the transport distance with the long transport method averages 63 feet. The elapsed time required per 100 cattle is 0.79 hour.

The labor requirement is 0.79 man-hour and the labor cost is 99 cents. The equipment cost is 21 cents, based on the use of 600 trolleys, 403 feet of dressing rail, and 22 1–L and 1–R dressing rail switches, for 0.79 machine-hour each, for a total of 2.37 machine-hours. The total labor and equipment cost is $1.20.

Comparison of two methods.—The total labor and equipment costs per 100 cattle for moving carcasses from the chill cooler to the holding cooler by the short transport method is 86 cents, as compared with $1.20 with the long transport method (table 8). The long transport method is associated with the improved layout which provides a larger chill and holding cooler area (for efficiently reducing body temperature from carcasses and holding them without crowding in the holding cooler until they are sold).

Order Assembly

Order assembly involves locating, in the holding cooler, sides of carcasses which are required for filling orders, and moving the carcasses to a working rail in the cooler. Two methods are used, the manual transport and the transport on-the-rail.

Manual transport method.—This method is performed with a 5-man crew. Four of these workers are divided into two 2-man crews. One worker calls out the information needed for filling orders to the crews. He also assists the crews in locating sides of carcasses. The crews alternate in manually transporting designated sides of carcasses from the holding rail in the cooler to the working rail. The average transport distance for the typical holding cooler is 10 feet. The elapsed time per 100 cattle of the typical weight group is 1.71 hours.

The labor requirement, 8.55 man-hours, includes 0.39 man-hour of unproductive labor due to the worker who calls information waiting for the workers who transport the carcasses. Total labor cost, $12.84, is based on $1.25 per hour for crew workers and $2.50 per hour for the call-out worker. Equipment cost, 28 cents, is based on the use of 600 trolleys, 213 feet of dressing rail, 7 1–L and 1–R dressing rail switches, and one 3-way dressing rail switch for 1.71 machine-hours each, for a total of 6.84 machine-hours. The total labor and equipment cost per 100 cattle of the typical weight group is $13.12.

Transport-on-the-rail method.—This method is performed with a 4-man crew. One worker locates the necessary sides of carcasses for filling orders and calls out the information to the other three workers, who alternate in transporting designated sides from the holding cooler to the working rail. The average transport distance, based on an improved layout, is 30 feet. The elapsed time per 100 cattle of the typical weight group is 1.53 hours.

The labor requirement, 6.12 man-hours, includes 0.21 man-hour of unproductive labor due to the worker who locates carcasses and calls out information waiting for the workers who transport the carcasses. Labor cost, $9.56, is based on a wage rate of $1.25 per hour for the 3 workers transporting and $2.50 per hour for the worker calling out orders. Equipment cost, 41 cents, is based on 600 trolleys, 403 feet of dressing rail, and 22 dressing rail switches, for 1.53 machine-hours each, for a total of 4.59 machine-hours. The total labor and equipment cost per 100 cattle of the typical weight group is $9.97.

Comparison of two methods.—The total labor and equipment cost for order assembly of 100 carcasses by the manual transport method is $13.12, as compared with $9.97 by the transport-on-the-rail method (table 8). All the reduction is in the labor cost. Less labor is required for transporting sides of carcasses on-the-rail than for transporting them manually. The equipment cost for the transport-on-the-rail method is slightly higher because a larger holding cooler, which requires more rail and more switches, is employed.

Summary of Requirements for Chilling and Holding Cooler Operations

The total labor and equipment cost for performing chilling and holding cooler operations for carcasses of 100 cattle by combination A methods is $16.03, as compared with $13.11 by combination B methods. A reduction of $2.92 per 100 cattle is incurred with combination B (table 8). All the reduction in the labor cost is incurred in the order assembly operation, and is the result of transporting carcasses by the on-the-rail method rather than by the manual method. A 26-cent increase in equipment costs is incurred with combination B and is due to additional rail and switches required in the larger holding cooler.

Boning Room Operations

The typical plant slaughtering 100 cattle daily bones out the carcasses of about 10 percent of its slaughter. Therefore, boning room operations are based on boning out the carcasses of 10 cattle. Boning room operations consist of transporting carcass sides to the boning room, cutting and

TABLE 8.—*Summary of labor and equipment requirements per 100 cattle for performing chilling and holding cooler operations, by combinations of methods, in plants slaughtering 100 cattle daily of the typical weight group* [1]

Operation	Combination A methods [2]					Combination B methods [3]				
	Labor and equipment requirements		Labor and equipment costs			Labor and equipment requirements		Labor and equipment costs		
	Labor	Equipment	Labor	Equipment	Total	Labor	Equipment	Labor	Equipment	Total
	Man-hours	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*	*Man-hours*	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*
Removing shrouds	1. 36	4. 08	1. 70	0. 35	2. 05	1. 25	3. 75	1. 56	0. 38	1. 94
Transporting carcasses	. 61	2. 44	. 76	. 10	. 86	. 79	2. 37	. 99	. 21	1. 20
Order assembly	8. 55	6. 84	12. 84	. 28	13. 12	6. 12	4. 59	9. 56	. 41	9. 97
Total	10. 52	13. 36	15. 30	. 73	16. 03	8. 16	10. 71	12. 11	1. 00	13. 11

[1] Based on 50 percent weighing 150 to 349 pounds, 40 percent weighing from 350 to 599 pounds, and 10 percent weighing from 600 to 900 pounds (dressed weight).

[2] Removing shrouds by manual method; transporting carcasses by short transport method; and order assembly by manual transport method.

[3] Removing shrouds by tub truck method; transporting carcasses by long transport method; and order assembly by transport on-the-rail method.

boning, and transporting bones to the dock. The temperature of the boning room should be approximately 55° F.

Transporting Carcass Sides to the Boning Room

Carcass sides are transported from the working rail in the holding cooler to the boning room for cutting and boning. Two methods are used, the manual transport and the on-the-rail transport.

MANUAL TRANSPORT METHOD.—This method involves moving carcass sides (4 at a time) on-the-rail from the work rail to a point opposite the boning room door. At this point the sides are quartered, and each quarter is manually transported to and placed on the boning table. Two workers perform the operation. One worker transports the sides of carcasses to the point opposite the boning room door. The average transport distance is 45 feet and the elapsed time required to transport the carcasses is 0.04 hour. At this point, the second worker quarters the sides while the first worker manually transports the quarters an average of 25 feet to the boning room table. The elapsed time required for quartering 10 carcass sides and transporting the quarters to the boning room table is 0.25 hour. The total elapsed time is 0.29 hour.

The labor requirement is 0.54 man-hour because the worker who quarters the carcasses performs this job in conjunction with other duties. The labor cost is 68 cents. No equipment costs are allocated because the overhead rail in the holding cooler is charged to the order assembly and loadout operations and no overhead rail is located in the boning room.

TRANSPORT-ON-THE-RAIL METHOD.—One worker moves carcasses (4 sides at a time) on an overhead rail from the working rail in the holding cooler to a position directly over the boning table. He then quarters the sides, and places the quarters on the table. The average transport distance is 55 feet. The elapsed time is 0.50 hour.

The labor requirement is 0.50 man-hour and the labor cost is 63 cents. The equipment requirement, 2 cents, is based on the use of 24 feet of dressing rail (that extends from the load-out dock scale to a point opposite the boning room door) and a dressing rail switch, for 0.50 machine-hour each, for a total of 1.00 machine-hour. The total labor and equipment cost per 10 cattle is 65 cents.

COMPARISON OF TWO METHODS.—The total labor and equipment cost per 10 cattle for transporting carcasses from the working rail in the holding cooler to the boning room by the manual method is 68 cents, as compared with 65 cents by the transport-on-the-rail method (table 9). All the reduction is in the labor cost. The equipment costs are naturally higher for the on-the-rail method because no equipment is chargeable to the operation when the manual method is used.

Cutting and Boning

Cutting involves breaking forequarters and hindquarters into primal cuts such as loin, round, rib, shank, plate, and chuck. Boning involves removing the bones from the meat of the primal cuts (fig. 10), cutting the meat into comparatively small pieces, and placing the meat in tub trucks. Only one method of cutting and boning was observed—the manual method.

MANUAL METHOD.—One worker, using a handsaw, breaks the forequarters and hindquarters into primal cuts and stacks them on the boning table. He also performs other duties in connection with the job. A second worker, using a hand knife, removes the bones from the primal cuts and throws them into barrels, cuts up the meat and throws it into a tub truck, and periodically sterilizes his knife. The elapsed time for breaking

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FIGURE 10.—Removing bones from primal cuts in the boning room.

the quarters of 10 cattle into primal cuts is 0.40 hour. The elapsed time required for boning is 6.68 hours.

The labor requirement is 7.08 man-hours. The labor cost is $17.28. The equipment cost is $1.90, based on the use of 2 boning tables and 7 tub trucks, for 6.68 machine-hours each, a band saw for 0.40 machine-hour, and a sterilizing laboratory for 0.03 machine-hour, for a total of 60.81 machine-hours. The total labor and equipment cost per 100 cattle is $19.18.

Transporting Bones to Dock

This operation involves transporting barrels of bones from the boning room to the inedible offal dock and transporting empty barrels from the dock to the boning room. Two methods are used, the long transport and the short transport.

Both methods are dependent on the distance the barrels are transported. The long transport method is based on the distances involved in the typical layout (fig. 16) and the short transport method is based on the proposed layout (fig. 17). For the typical weight group, six 55-gallon barrels of bones per 10 carcasses are transported to the inedible offal dock. The barrels are transported periodically, and one worker using a barrel truck performs the operation by both methods.

LONG TRANSPORT METHOD.—Barrels of bones are transported on barrel trucks an average distance of 90 feet with this method. The return distance with empty barrels is the same. The elapsed time for the operation is 0.10 hour.

The labor requirement is 0.10 man-hour and the labor cost is 13 cents. The equipment cost is less than one-half cent and is not included in cost computation.

SHORT TRANSPORT METHOD.—Bones are transported an average distance of 70 feet with this method. The elapsed time is 0.08 hour.

The labor requirement is 0.08 man-hour, and the labor cost is 10 cents. The equipment cost of less than one-half cent is not included in cost computation.

COMPARISON OF TWO METHODS.—The total cost for transporting the bones from 10 carcasses by the long transport method is 13 cents, as compared with 10 cents with the short transport method (table 9). The reduction is in the labor cost and is due to the shorter transport distance required by an improved layout.

Summary of Requirements for Boning Room Operations

The total labor and equipment costs for boning room operations in boning the carcasses of 10 cattle of the typical weight group by combination A methods is $19.99 as compared with $19.93 with combination B methods (table 9). Practically all the reduction is in the labor cost and is due to an

TABLE 9.—*Summary of labor and equipment requirements and costs per 10 cattle for performing boning room operations in plants boning 10 cattle of the typical weight group daily by combinations of methods* [1]

Operation	Combination A methods [2]					Combination B methods [3]				
	Labor and equipment requirements		Labor and equipment costs			Labor and equipment requirements		Labor and equipment costs		
	Labor	Equipment	Labor	Equipment	Total	Labor	Equipment	Labor	Equipment	Total
	Man-hours	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*	*Man-hours*	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*
Transporting carcass sides to boning room	0. 54	0	0. 68	0	0. 68	0. 50	1. 00	0. 63	0. 02	0. 65
Cutting and boning	7. 08	60. 81	17. 28	1. 90	19. 18	7. 08	60. 81	17. 28	1. 90	19. 18
Transporting bones to dock	. 10	0	. 13	0	. 13	. 08	0	. 10	0	. 10
Total	7. 72	60. 81	18. 09	1. 90	19. 99	7. 66	61. 81	18. 01	1. 92	19. 93

[1] Based on 50 percent of animals slaughtered weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weight).

[2] Transporting carcass sides to boning room by the manual transport method; cutting and boning by the manual method; and transporting bones to dock by the long transport method.

[3] Transporting carcass sides to boning room by the transport on-the-rail method; cutting and boning by the manual method; and transporting bones to dock by the short transport method.

improved layout which reduces the distances for transporting carcasses from the holding cooler to the boning room and for transporting bones from the boning room to the inedible offal dock.

Load-Out Dock Operations

The load-out dock operations include: Weighing and loading out carcasses and weighing and loading out boned meat. The carcasses are moved from the holding cooler to the dock where they are weighed, grades are applied, and the carcasses are loaded into trucks. The boned meat is packed into boxes or barrels, weighed, moved from the boning room to the dock, and loaded into trucks. These operations are based on the sides of 90 carcasses and the boned meat from 10 carcasses.

Weighing and Loading Out Carcasses

Carcass sides are transported from the holding cooler working rail to the load-out dock and weighed, the appropriate grade is rolled on each carcass side, and the 90 carcasses are loaded onto trucks for shipment. (Grading is not usually performed by a plant employee, therefore, it is not considered a part of the operation.) Two methods are used, the quarter stacking and the carcass side rail truck.

Quarter stacking method.—This method involves: Transporting sides of 90 carcasses on the overhead rail from the holding cooler to the track scale on the load-out dock, weighing each carcass, rolling grade on each carcass side, quartering carcass sides, and loading quarters into truck (fig. 11).

Five workers perform the operation. Two workers transport the carcasses on the rail to the load-out dock scale and transport them into the truck after they are weighed and quartered (fig. 12). These two workers alternate in transporting the quarters into the truck and placing paper between the layers of stacked quarters. The third worker weighs each carcass and records the weight data. The fourth worker transports each carcass off the scales and rolls grades on each carcass side. (After all the carcasses are weighed and the grades rolled on all carcass sides, these two workers are free to perform other work in the plant.) The fifth worker partially severs each carcass after the grades are rolled on and completes quartering each side when the two transporting workers are ready to transport the quarters into the truck. This worker also uses a pike pole to remove the trolley from the hindquarter and overhead rail. He then throws the trolley into a storage barrel. The elapsed time is 1.85 hours.

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Figure 11.—Beef sides being quartered and carried to truck at load-out dock.

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Figure 12.—Loading a truck by the quarter stacking method.

The labor requirement, 6.09 man-hours, includes 0.18 man-hour unproductive labor caused by the two transporting workers waiting on the weighing worker. The labor cost is $8.13. The equipment cost, 76 cents, is based on the use of 600 trolleys, 50 feet of dressing rail, and a dial track scale, for 1.76 machine-hours each, for a total of 5.28 machine-hours. The total labor and equipment cost is $8.89.

Carcass side rail truck method.—This method involves: transporting sides of 90 carcasses

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FIGURE 13.—Overhead rail system in truck used for shipping beef sides.

on the overhead rail from the holding cooler to the track scale on the load-out dock, weighing each carcass, rolling grade on each carcass side, and loading carcass sides into a truck equipped with overhead rails (fig. 13). A section of rail is bolted to the truck and the load-out dock rails to permit carcass sides to be loaded on-the-rail into the truck The same system could be used to load quarters (fig. 14). Four workers perform the operation. Two workers transport the carcasses on-the-rail to the load-out dock scale. After the sides are weighed and graded, one of these workers moves them on-the-rail into the truck; the other positions them on-the-rails in the truck. The third worker—at the load-out scale—weighs each carcass and records the weight data. The fourth worker transports carcasses off the scales and rolls grades on each carcass side.

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FIGURE 14.—Rail truck used for shipping quarters.

(After all the carcasses are weighed and the grades rolled on, these two workers perform other work in the plant.) The elapsed time is 0.89 hour.

The labor requirements are 2.61 man-hours and the labor cost is $3.79. The equipment cost is 70 cents based on the use of 600 trolleys, 57 feet of dressing rail, and a dial track scale, for 0.89 machine-hour each, for a total of 2.67 machine-hours. The total labor and equipment cost is $4.49.

COMPARISON OF TWO METHODS.—The total labor and equipment cost for weighing and loading out 90 carcasses by the quarter stacking method is $8.89, as compared with $4.49 by the carcass side rail truck method (table 10). The reduction amounts to $4.40, with all the reduction except 6 cents being in labor cost. The reduction in labor cost is due to a smaller crew and the use of improved methods.

Weighing and Loading Out Boned Meat

Boned meat from 10 carcasses is packed into boxes or barrels in the boning room, weighed, transported to the load-out dock, and loaded into trucks. Two methods are used, the box and the barrel.

BOX METHOD.—This method involves: Packing boned meat into 100-pound boxes, weighing, strapping and stenciling boxes, loading boxes onto a semilive skid, transporting them to the load-out dock, and loading them into trucks. Two workers perform the operation. One worker transports boned meat in a 500-pound capacity tub truck from a point adjacent to the boning table to the packaging table, packs it into boxes on the scale, weighs the filled box, straps, stencils and places filled box onto a semilive skid, and transports the skid to the load-out dock. The second worker assists in manually loading the boxes into the truck. The elapsed time is 1.13 hours.

The labor requirements are 1.27 man-hours and the labor cost is $1.99. The equipment cost is 49 cents, based on the use of a packaging table and bench scales with stand, for 0.97 machine-hour each, and a semilive skid for 1.27 machine-hours, for a total of 3.21 machine-hours. The total labor and equipment cost is $2.48.

BARREL METHOD.—This method involves: Transporting barrels of boned meat with a two-wheel panel truck an average of 40 feet from the boning room to the dial floor scales on the load-out dock, weighing the barrels, transporting them an average of 15 feet, placing them in the truck, and returning an average distance of 30 feet to the boning room. One worker performs the operation. The elapsed time is 0.36 hour.

The labor requirement is 0.36 man-hour and the labor cost is 45 cents. The equipment cost is 58 cents based on the use of a dial floor scale for 0.18 machine-hour and a 2-wheel barrel truck for 0.36 machine-hour, for a total of 0.54 machine-hour. The total labor and equipment cost is $1.03.

Comparison of two methods.—The total labor and equipment cost for weighing and loading out boned meat from 10 carcasses by the box method is $2.48, as compared with $1.03 by the barrel method (table 10). The reduction of $1.45 is in the labor cost and is due to elimination of labor in packaging meat in barrels. The slight increase in equipment cost is due to the use of dial floor scales to weigh barrels of boned meat.

Summary of Requirements for Load-Out Dock Operations

The total labor and equipment cost for performing the load-out dock operations for 100 cattle (carcass sides of 90 cattle and boned meat of 10 cattle) by combination A methods is $11.37, as compared with $5.52 by combination B. A reduction of $5.85 per 100 cattle is incurred with combination B (table 10). All of the reduction is in the labor cost. Approximately 75 percent of the reduction is in the weighing and loading out carcasses operation and about 25 percent in the weighing and loading out boned meat operation. The labor cost reduction in both operations is due to improved methods that minimize manual handling and permit each operation to be performed with fewer workers. The equipment costs for the two combinations of methods are approximately the same.

Offal Chilling Cooler Operations

Offal chilling cooler operations consist of: Transporting edible offal from the head work-up and separating-pluck work areas and the viscera washing and separating room to the chilling cooler, and storing it. Edible offal consists of livers, hearts, tails, tongues, head and cheekmeat, and tripe.

Transporting Edible Offal

Livers, hearts, tails, tongues, and head and cheekmeat are transported from the head work-up and separating-pluck work areas to the chilling room, and tripe is transported from the viscera washing and separating room. The average transport distance, based on the typical layout (fig. 16), is 80 feet. The typical layout does not have an edible offal chilling cooler room; consequently offal is transported to the boning room and carcass holding coolers and stored there. The suggested layout (fig. 17) provides an edible offal cooler. The average transport distance for edible offal based on the suggested layout is 40 feet. Two methods are used, the long transport method, based on the typical layout, and the short transport method, based on the suggested layout.

Long transport method.—One worker performs this operation. Tripe is transported by tub trucks from the viscera wash and separating room to the boning room; hearts, tongues, and head and cheekmeat are transported by tub trucks from the head workup and pluck working areas to the boning room; livers are transported on an offal hanging truck from the pluck working area to the carcass holding cooler. Tails are transported in stainless steel pans placed in tub trucks from the pluck working area to the boning room. The operations also include transporting and locating empty containers. The average transport distance is 80 feet, and 15 trips are required to transport the edible offal from 100 cattle of the typical weight group. The elapsed time is 0.20 hour.

The labor requirement is 0.20 man-hour and the labor cost is 25 cents. The equipment cost is $1.23, based on the use of 8 tub trucks and 2 offal hanging trucks for 0.20 machine-hour each, for a total of 2.00 machine-hours. The total cost is $1.48.

Short transport method.—With the short transport method, livers, tongues, and hearts are transported on offal hanging trucks from the separating-pluck work area to the edible offal cooler. Tripe, head and cheekmeat are transported in tub trucks. Tails are transported in stainless steel pans placed in tub trucks. The average distance of travel is 40 feet, and 10 trips are required for transporting the edible offal from 100 cattle of the typical weight group. The elapsed time is 0.11 hour.

The labor requirement is 0.11 man-hour and the labor cost is 14 cents. The equipment cost is $1.13, based on the use of 6 tub trucks and 3 offal hanging trucks, for 0.11 machine-hour each, for a total of 0.99 machine-hour. The total labor and equipment cost is $1.27.

Comparison of two methods.—The total labor and equipment cost of the transporting edible offal operation for 100 cattle by the long transport method is $1.48, as compared with $1.27 by the short transport method (table 11). The reduction of 21 cents is about equally divided between labor and equipment. The reduction in equipment cost is caused by the difference in costs of tub trucks and offal hanging trucks. The reduction in labor cost is caused by the shorter transport distance and fewer trips.

Storing Edible Offal

In the offal chilling cooler, livers, tongues, tripe, and tails are manually transferred from the transporting containers to offal hanging cages, storage racks, or pan racks. Other items are stored in the cooler in the transporting containers. Two methods are used for transferring and storing livers, tongues, tripe and tails, the combined cooler and the separate cooler. The combined cooler method is based on the layout for the typical plant that uses the boning room and the carcass holding cooler for storing edible offal. The separate cooler method is based on the suggested plant layout which provides an edible offal chilling cooler.

Combined cooler method.—One worker transfers livers, tongues, and tails from containers to offal hanging cages and pan racks. Livers are

TABLE 10.—*Summary of labor and equipment requirements and costs for performing load-out dock operations by combination of methods in plants slaughtering 100 cattle daily* [1]

Operation	Combination A methods [2]					Combination B methods [3]				
	Labor and equipment requirements		Labor and equipment costs			Labor and equipment requirements		Labor and equipment costs		
	Labor	Equipment	Labor	Equipment	Total	Labor	Equipment	Labor	Equipment	Total
	Man-hours	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*	*Man-hours*	*Machine hours*	*Dollars*	*Dollars*	*Dollars*
Weighing and loading out carcasses [4]	6. 09	5. 28	8. 13	0. 76	8. 89	2. 61	2. 67	3. 79	0. 70	4. 49
Weighing and loading out boned meat [5]	1. 27	3. 21	1. 99	. 49	2. 48	. 36	. 54	. 45	. 58	1. 03
Total	7. 36	8. 49	10. 12	1. 25	11. 37	2. 97	3. 21	4. 24	1. 28	5. 52

[1] Based on 50 percent weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weight).
[2] Using quarter stacking method for carcasses, and box method for boned meat.
[3] Using side rail truck method for carcasses, and barrel method for boned meat.
[4] Based on 90 carcasses.
[5] Based on boned meat of 10 carcasses.

transferred (2 at a time) from the offal hanging trucks to offal hanging cages (fig. 15). Tongues are transferred from tub trucks onto the cages. Livers and tongues are stored in the carcass holding room. Tails are transferred from tub trucks and placed in pan racks located in the boning room. Tripe is stored in its transporting container in the boning room. The elapsed time is 0.72 hour.

The labor requirement is 0.72 man-hour. The labor cost is 90 cents. The equipment cost is 27 cents, based on the use of 2 offal hanging cages and 2 offal pan racks, for 0.72 machine-hour each, for a total of 2.88 machine-hours. The total labor and equipment cost is $1.17.

SEPARATE COOLER METHOD.—This method is performed by one worker who manually transfers livers and tongues from offal hanging trucks to storage racks. Pans of tails are removed from tub trucks and placed in pan racks. Tripe is transferred from tub trucks onto storage racks. The elapsed time is 0.70 hour.

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FIGURE 15.—Hearts, livers, and tongues stored on offal-hanging trucks.

The labor requirement is 0.70 man-hour and the labor cost is 88 cents. The equipment cost is 23 cents, based on the use of 2 offal pan racks and 2 offal storage racks for 0.70 machine-hour each, for a total of 2.80 machine-hours. The total labor and equipment cost is $1.11.

COMPARISON OF TWO METHODS.—The total labor and equipment cost for storing edible offal from 100 cattle by the combined cooler method is $1.17, as compared with $1.11 by the separate cooler method (table 11). Most of the 6-cent reduction is in the equipment cost and is caused by the difference in costs of offal hanging cages and storage racks. The reduction in labor cost is due to working in only one room and the faster pace of transferring livers and tongues from offal hanging trucks to storage racks rather than from tub trucks to offal hanging cages.

Summary of Requirements for Offal Chilling Cooler Operations

The labor and equipment cost per 100 cattle for performing offal chilling cooler operations with combination A methods is $2.65, as compared with $2.38 with combination B methods (table 11). The reduction is in both the cost of labor and equipment. The reduction in labor cost is due to fewer trips being required when offal hanging trucks are used and a shorter transport distance because of an improved layout. The reduction in equipment cost is due to the difference in costs of the tub truck and offal hanging cage and the offal hanging truck and the storage rack.

Equipment Washroom Operation—Cleaning Trolleys

Only one operation is performed in the equipment washroom—cleaning trolleys. The equip-

TABLE 11.—*Summary of labor and equipment requirements per 100 cattle for offal chilling cooler operations, by combinations of methods, in plants slaughtering 100 cattle daily* [1]

Operation	Combination A methods [2]					Combination B methods [3]				
	Labor and equipment requirements		Labor and equipment costs			Labor and equipment requirements		Labor and equipment costs		
	Labor	Equipment	Labor	Equipment	Total	Labor	Equipment	Labor	Equipment	Total
	Man-hours	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*	*Man-hours*	*Machine-hours*	*Dollars*	*Dollars*	*Dollars*
Transporting edible offal	0. 20	2. 00	0. 25	1. 23	1. 48	0. 11	0. 99	0. 14	1. 13	1. 27
Storing edible offal	. 72	2. 88	. 90	. 27	1. 17	. 70	2. 80	. 88	. 23	1. 11
Total	. 92	4. 88	1. 15	1. 50	2. 65	. 81	3. 79	1. 02	1. 36	2. 38

[1] Based on 50 percent weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weight).
[2] Transporting edible offal by the long method and storing it by the combined cooler method.
[3] Transporting edible offal by the short method and storing it by the separate cooler method.

ment washroom is a separate room which adjoins the killing floor. It is equipped with a 3-section vat; one section contains a cleansing mixture; one, a rinsing mixture; and one, oil. It also contains a hoist for lowering trolleys into the vats.

All trolleys are cleaned after they are removed from the carcasses on the load-out dock and before they are used again on the killing floor. Trolleys are transported from the load-out dock, where they are stored in barrels after removal from carcasses, to the equipment washroom, where they are washed, rinsed, and oiled. They are then transported to the killing floor. Two methods are used to perform the operation, the transport and hang and transport on-the-rail. One worker performs the operation by each method.

TRANSPORT AND HANG METHOD.—The worker removes the trolleys from the barrel on the load-out dock, hangs them on a 2-wheel hand truck, and transports them an average distance of 120 feet to the equipment washroom. Fifty trolleys are transported per load, and 4 loads are necessary for the trolleys for 100 cattle. He then removes them from the truck and hangs them (25 at a time) on a hoist so they can be lowered into the vats for cleaning. He dips them into the vat containing the cleansing mixture, the vat with rinsing fluid, and the vat with oil. He manually removes them from the hoist and hangs them on the truck, transports them 40 feet to the skinning bed area on the killing floor and hangs them on a stationary rack. The elapsed time to clean trolleys for 100 cattle is 2.60 hours.

The labor requirements are 2.60 man-hours and the labor cost $3.25. The equipment cost is 40 cents, based on the use of two 2-wheel hand trucks for 2.60 machine-hours each, a trolley storage rack for 0.98 machine-hour, 10 feet of dressing rail, a 3-section dip vat with legs, and a hoist for the trolley dip, for 1.81 machine-hours each, for a total of 11.61 machine-hours. The total labor and equipment cost is $3.65.

TRANSPORT-ON-THE-RAIL METHOD.—The worker transports the trolleys from the overhead rail on the load-out dock to the equipment washroom, an average distance of 20 feet. One hundred trolleys are transported per load, and 2 loads are necessary for the trolleys for 100 cattle. The worker places a trolley-holding fixture on the hoist and transfers the trolleys (40 at a time) from the rail to the fixture. He dips the trolleys into the vat containing the cleansing mixture, the vat with rinsing fluid, and the vat with oil. After each group of 40 trolleys has been cleaned, the worker lowers the fixture into a caster base which converts the fixture into a transport rack. He then transports the trolleys (40 at a time) a distance of 40 feet to the skinning bed area on the killing floor. The elapsed time to clean trolleys for 100 cattle is 0.96 hour.

The labor requirement is 0.96 man-hour and the cost $1.20. The equipment cost is 39 cents, based on the use of a 3-section dip vat for 0.75 machine-hour, a hoist for trolley dip for 0.86 machine-hour, and 3 dip and transport racks for 0.86 machine-hour; 35 feet of dressing rail for 0.85 machine-hour, and a dressing rail switch for 0.10 machine-hour, for a total of 3.42 machine-hours. The total labor and equipment cost for cleaning trolleys for 100 cattle is $1.59.

COMPARISON OF TWO METHODS.—The total labor and equipment cost for cleaning trolleys with the transport and hang method is $3.65, as compared with $1.59 with the transport on-the-rail method. Practically all the $2.06 reduction is in labor, due to transporting trolleys on-the-rail and on the transport rack rather than on 2-wheel hand trucks. Also, the transport distances with the on-the-rail method are shorter, due to the improved layout.

Plant Cleaning Operations

Cleaning is an important function. The cleaning standards are determined and enforced by the inspection service employed by the plant. Most plants clean certain areas periodically throughout the operating period. However, at the end of each workday, a general cleanup of all operating

departments is necessary. Cleaning, as referred to herein, pertains only to this general cleanup. The operating departments cleaned daily are: The killing floor, hide room, viscera washing and separating room, chilling and holding coolers, boning room, load-out dock, offal chilling cooler, and equipment washroom. Other departments, such as the office and welfare rooms, also are cleaned daily; however, this cleaning is not considered part of the study.

Cleaning includes: Hosing or washing down floors, steam cleaning plant equipment, and oiling certain pieces of equipment, particularly the equipment that comes in constant contact with edible products, with a special oil.

All the work, except that performed in the chilling and holding coolers, is usually begun immediately after daily slaughtering and processing have ceased. The coolers are cleaned during the day when coolers are not filled to capacity.

The number of workers used in cleaning each plant area varies widely because, in most plants, workers clean their own departments. For the purpose of this analysis, however, one worker performs all the cleaning work.

The same method of cleaning was employed by all plants in which studies were conducted. However, labor and equipment requirements for cleaning vary widely by departments. The size of the department also affects the labor and equipment requirements. The areas of some departments of the proposed plant are larger than those of the typical plant. Therefore, the labor and equipment requirements are compared on the basis of the present method (for the typical plant) and the revised method (for the suggested plant).

Present method.—The area of the departments in the typical plant (fig. 16) and the elapsed time required for a worker to clean them are as follows: Killing floor 1,759 square feet, the elapsed time 3 hours; hide room 156 square feet, elapsed time 0.11 hour; viscera washing and separating room 308 square feet, elapsed time 0.20 hour; chilling and holding coolers 1,740 square feet, elapsed time 0.73 hour; boning room 620 square feet, elapsed time 0.36 hour; load-out dock 224 square feet, elapsed time 0.12 hour; and the equipment washroom 225 square feet, elapsed time 0.12 hour. The total area cleaned is 5,032 square feet and the total elapsed time required is 4.64 hours.

The labor requirements are 4.64 man-hours and the cost is $5.80. The equipment cost is $1.60, based on the use of 175 feet of cleaning hose (including the cost of the water) for 4.64 machine-hours. The total cost is $7.40.

Revised method.—The area of the departments in the suggested plant (fig. 17) and the elapsed time required for a worker to clean them are: Killing floor 1,675 square feet, 3 hours; hide room 297 square feet, 0.12 hour; viscera wash and separating room 408 square feet, 0.25 hour; chilling and holding coolers 2,400 square feet, 0.94 hour; boning room 437 square feet, 0.25 hour; load-out dock 498 square feet, 0.20 hour; offal chilling cooler 210 square feet, 0.13 hour; and the equipment washroom 182 square feet, 0.08 hour. The total area cleaned is 6,107 square feet and the total elapsed time required is 4.97 hours.

The labor requirements are 4.97 man-hours and the cost is $6.21. The equipment cost is $1.72, based on the use of 175 feet of cleaning hose (including the cost of water) for 4.97 machine-hours. The total labor and equipment cost for cleaning per 100 cattle is $7.93.

Comparison of two methods.—The total labor and equipment cost for cleaning by the present method is $7.40, as compared with $7.93 by the revised method. Practically all of the increase is in the cost of labor and is due to cleaning an additional 1,075 square feet, most of which is in the chilling and holding coolers.

Approximately 65 percent of the total cleaning cost by both methods occurs in cleaning the killing floor. The comparatively high cost for cleaning the killing floor is primarily because most of the equipment that is steamed and oiled is in this room.

Summary of Requirements for Slaughter Plant Operations

The total cost per 100 cattle for performing slaughtering operations in a plant slaughtering 100 cattle daily of the typical weight group with combination A methods is $235.22, as compared with $184.68 with combination B (table 12). The reduction amounts to $50.54 per 100 animals, or 50 cents per head. On a yearly basis the reduction would amount to about $13,000.

All the reduction in costs with combination B is in the cost of labor; equipment cost is slightly higher. Labor cost with combination A is $216.37 per 100 cattle, as compared with $165.21 for combination B. The reduction in labor cost with combination B amounts to $51.16. The reduction in labor with combination B is 32.52 man-hours per 100 cattle, or about one-third man-hour per animal slaughtered.

Some reduction in labor cost is incurred in all operating cycles except the cleaning cycle. However, the greatest reduction in labor cost is in the killing floor operating cycle and is due primarily to improved work methods and plant layout. Improved work methods enable operations to be performed in a shorter period of time, thereby resulting in less labor (productive and unproductive). An improved plant layout permits shorter distances of movement for worker and materials between work stations.

Reduction in the labor cost in the hide room, viscera washing and separating room, chilling and holding coolers, boning room, load-out dock, and equipment washroom operating cycles also are due to improved work methods and plant layout.

The labor cost in cleaning with combination A

TABLE 12.—*Summary of requirements, by combinations of methods and major operating cycles, for a plant slaughtering 100 cattle daily* [1]

Operating cycle	Combination A methods [2]					Combination B methods [3]				
	Labor and equipment requirements		Labor and equipment costs			Labor and equipment requirements		Labor and equipment costs		
	Labor	Equipment	Labor	Equipment	Total	Labor	Equipment	Labor	Equipment	Total
Killing floor:										
Line slaughtering operations	*Man-hours* 78. 61	*Machine-hours* 155. 39	*Dollars* 131. 39	*Dollars* 7. 40	*Dollars* 138. 79	*Man-hours* 57. 51	*Machine hours* 128. 27	*Dollars* 95. 41	*Dollars* 7. 81	*Dollars* 103. 22
Supporting operations	11. 26	21. 66	17. 05	. 85	17. 90	9. 67	35. 15	14. 84	. 81	15. 65
Subtotal	89. 87	177. 05	148. 44	8. 25	156. 69	67. 18	163. 42	110. 25	8. 62	118. 87
Hide room	3. 36	. 22	4. 20	. 04	4. 24	2. 47	0	3. 09	0	3. 09
Viscera washing and separating room	8. 02	8. 87	10. 02	3. 18	13. 20	7. 27	7. 75	9. 08	3. 18	12. 26
Chilling and holding coolers	10. 52	16. 08	15. 30	. 73	16. 03	8. 16	10. 71	12. 11	1. 00	13. 11
Boning room [4]	7. 72	60. 81	18. 09	1. 90	19. 99	7. 66	61. 81	18. 01	1. 92	19. 93
Load-out dock [5]	7. 36	8. 49	10. 12	1. 25	11. 37	2. 97	3. 21	4. 24	1. 28	5. 52
Offal chilling cooler	. 92	4. 88	1. 15	1. 50	2. 65	. 81	3. 79	1. 02	1. 36	2. 38
Equipment washroom	2. 60	11. 61	3. 25	. 40	3. 65	. 96	3. 42	1. 20	. 39	1. 59
Plant cleaning	4. 64	4. 64	5. 80	1. 60	7. 40	4. 97	4. 97	6. 21	1. 72	7. 93
Subtotal	45. 14	115. 60	67. 93	10. 60	78. 53	35. 27	95. 66	54. 96	10. 85	65. 81
Total	135. 01	292. 65	216. 37	18. 85	235. 22	102. 45	259. 08	165. 21	19. 47	184. 68

[1] Based on 50 percent weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weights).

[2] Combination A methods: Driving with corner drive method; immobilizing with rifle; dumping with sliding door; dry landing with nonautomatic lander; bleeding and head skinning with long rail; flooring with pritch plates; rumping, backing and eviscerating with split rail; dropping hide and sawing carcass with split rail; washing with split rail one-level platform; shrouding with one-level platform; weighing with beam scale; head workup with 2 work station; removing legs from killing floor with barrel; removing viscera from killing floor with long transport; removing head bones from killing floor with barrel; storing hides with barrel and hide house; separating plucks with combined work station; emptying paunches with slow lift; cleaning tripe with long transport; removing shrouds with manual method; transporting carcasses with short transport; order assembly with manual transport; transporting carcass sides to boning room with manual transport; cutting and boning with manual method; transporting bones to dock with long transport; weighing and loading out carcasses with quarter stacking; weighing and loading out boned meat with box; transporting edible offal with long transport; storing edible offal with combined cooler; cleaning trolleys with transport and hang; and plant cleaning with present method.

[3] Combination B methods: Driving with straight drive method; immobilizing with rifle; dumping with revolving door; dry landing with automatic lander; bleeding and head skinning with short rail; flooring with cradle; rumping, backing and eviscerating with monorail; dropping hide and sawing carcass with monorail: washing with monorail two-level platform; shrouding with two-level platform; weighing with dial scale; head workup with 1 work station; removing legs from the killing floor with gravity chute; removing viscera from killing floor with short transport; removing head bones from killing floor with gravity chute; storing hides with gravity chute and hide cellar; separating plucks with separate work station; emptying paunches with fast lift; cleaning tripe with short transport; removing shrouds with tub truck; transporting carcasses with long transport; order assembly with transport on-the-rail; transporting carcass sides to boning room with transport on-the-rail; cutting and boning with manual method; transporting bones to dock with short transport; weighing and loading out carcasses with carcass side rail truck; weighing and loading out boned meat with barrel; transporting edible offal with short transport; storing edible offal with separate cooler; cleaning trolleys with transport on-the-rail; and plant cleaning with revised method.

[4] Based on boning 10 carcasses.

[5] Based on loading out 90 carcasses and the boned meat of 10 carcasses.

methods is $7.40, as compared with $7.93 with combination B. The increase is due to the overall area of the improved layout (fig. 17) being larger than that of the typical plant (fig. 16).

The equipment cost with combination A is $18.85, as compared with $19.47 with combination B. This increase is due to more efficient equipment, with a higher cost.

LAYOUT FOR A CATTLE SLAUGHTERING PLANT

In preparing a layout for a cattle slaughtering plant, consider at least four factors: Carcass and byproduct flow, space utilization, equipment arrangement, and future expansion.

Paths of flow for carcass and byproducts should be short and direct and should minimize plant congestion. This necessitates not only the proper arrangement of plant components but also the proper location of related work areas in the various components.

The plant should be designed for the greatest utilization of space. Before room sizes are deter-

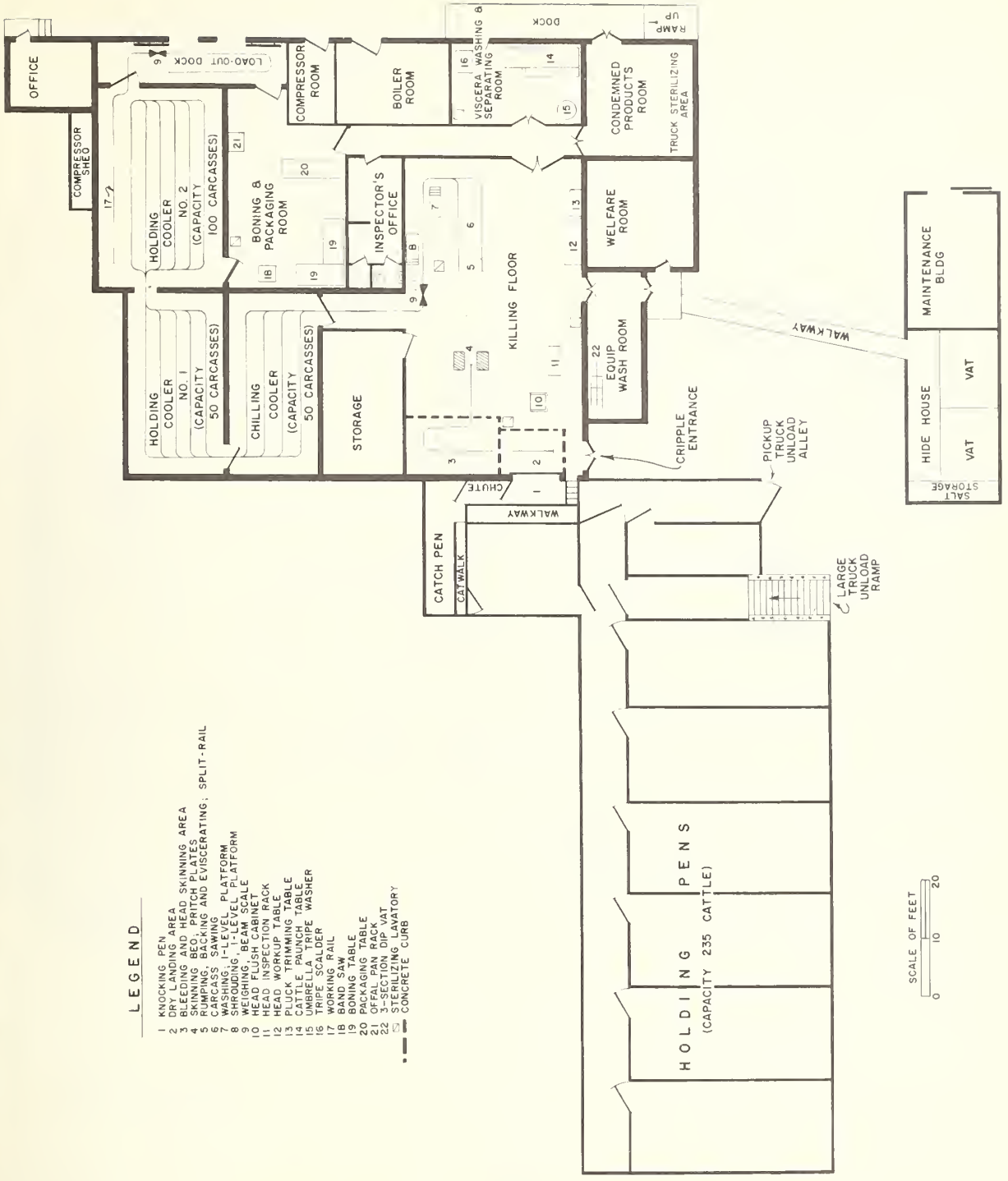

FIGURE 16.—Layout of a typical plant slaughtering 100 cattle daily.

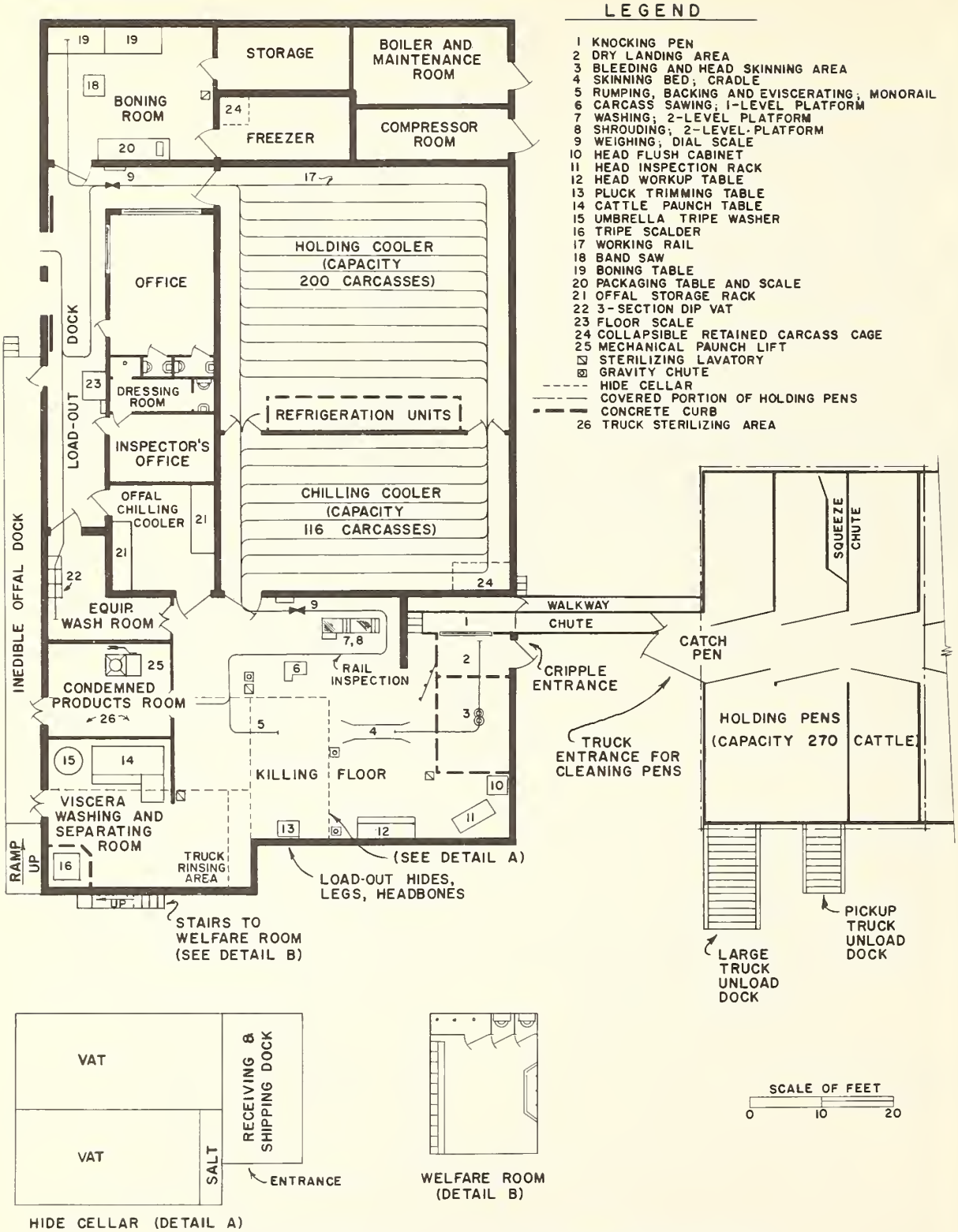

FIGURE 17.—Layout of a proposed plant slaughtering 100 cattle daily.

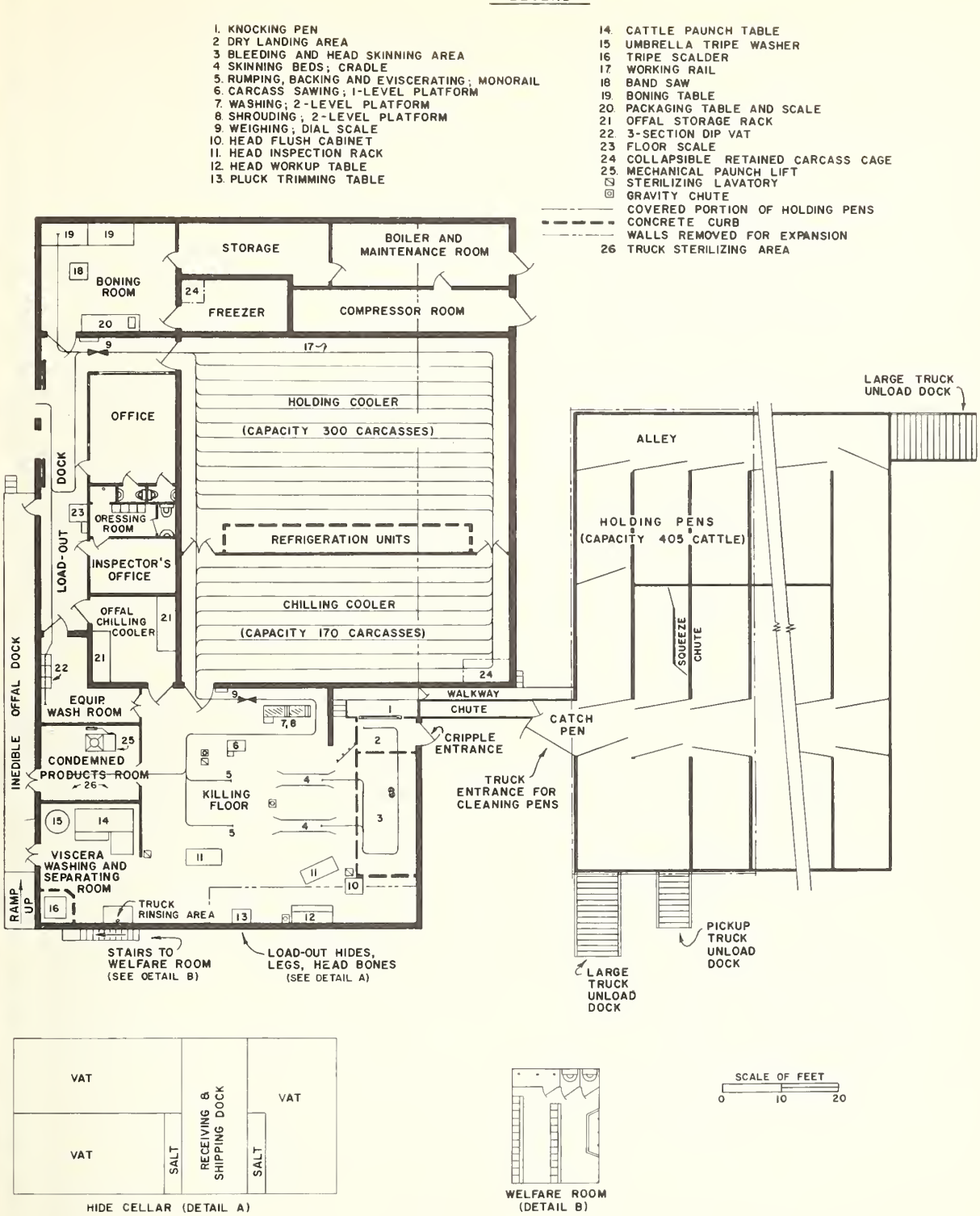

FIGURE 18.—Layout of a proposed plant expanded to slaughter a daily volume of 150 cattle.

mined, the volume of products to be handled, the space requirement of each item of equipment, and the working space requirements should be ascertained. For storage rooms, the number of items to be stored and the length of the storage period should be determined. Allowance should be made for aisles in all rooms, the size of the aisles depending upon the types of traffic.

The arrangement of equipment should provide for economy of movement of products between work stations, approved sanitation practices, and efficient performance of operations. This arrangement should insure minimum walking distances for workers and a minimum distance for moving carcasses and byproducts between work stations. It should also provide for the most direct flow, and therefore, the minimum footage of bleeding and dressing rails.

The plant should be designed so that expansion will not present a major construction problem. Where expansion is anticipated, removable nonbearing walls should be used, when possible. Plans for expansion should provide for the removal of a minimum amount of exterior wall.

Inspection and sanitation authorities have rigid requirements for slaughter plant construction. Operators planning new plants or the expansion of existing ones should submit their plans to proper authorities for approval before beginning construction.

Proposed Layout for a Plant Slaughtering 100 Cattle Daily

A proposed layout for a plant slaughtering 100 cattle daily with 50 percent of the animals weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weight) is shown in figure 17. The plant is designed to receive live animals, and to process 90 animals in carcass form and 10 animals as boned meat. Inedible offal, with the exception of hides, would be sent to a rendering plant. The major components of the plant are: holding pens, killing floor, chilling and holding coolers, hide cellar, viscera washing and separating room, boning room, load-out dock, offal chilling cooler, freezer room, offices, machinery rooms, and a welfare room.

The plant proper, the docks, and the holding pens cover 15,572 square feet. The plant covers an area approximately 120 feet long and 70 feet wide. It contains 8,275 square feet.

Holding Pens

Holding pens are an integral part of a slaughtering facility and are used for holding cattle prior to slaughter. To provide flexibility in purchasing cattle and to maintain an adequate supply of animals to prevent shutdowns, it is suggested that the holding pens provide space for about 2.7 times the number of cattle the plant slaughters daily. Thus, a plant slaughtering 100 cattle daily should provide space for about 270 cattle. The size of the pen area is affected by the sizes of the animals and the length of time they would be held. If cattle are to be held an average of 2 to 3 days, allow 18 square feet of pen space per animal. Thus, the pen area for 270 cattle would amount to 4,860 square feet.

To prevent injuries from crowding and to provide separate spaces for different buyers' lots, it is suggested that the pen area be divided into 23 pens. Twenty-two pens are 10 by 20 feet each and one pen is 20 feet square. The large pen would be used primarily for receiving animals and should be equipped with a dock 50 inches high for receiving animals from trailer trucks and a dock 24 inches high for cattle arriving on pickup trucks.

The pens should be divided equally into two rows by an alley 10 feet wide. Gates to the pens should be the same width as the alley so when the gates are open they will block the alley. The alley should lead directly to a chute 3 feet wide through which cattle are driven into the knocking pen. A roof should be constructed over an area about 50 by 30 feet (covering 5 pens and the chute) to protect workers inspecting cattle and driving them into the chute.

A squeeze chute should be located in one of the pens under the roof to hold cattle for close inspection.

Killing Floor

The suggested killing floor is one large room containing 1,675 square feet. It is 47 feet long. Its width varies from 34 to 41 feet. The immobilizing operation and all dressing operations are performed on the killing floor with each in a specific area. Specific areas are: Knocking pen, dry landing, bleeding and head skinning, flooring, rumping, backing, and eviscerating, dropping hide and carcass sawing, washing and shrouding, weighing, and head and pluck workup. The suggested arrangement for these areas is shown in figure 17.

Cattle and carcasses are suspended either by shackles or hooks attached to trolleys and are moved on an overhead rail, or by hoist, from one area to another, except for the head and pluck workup area where byproducts are handled.

The killing floor should be equipped with 24 feet of bleeding rail, with the top of the rail installed at least 16 feet above the floor, and 53 feet of dressing rail, with top installed 11 feet above the floor. On the bleeding rail, cattle and carcasses are moved with shackles and trolleys. The rail should extend from the dry landing area to the flooring area. Hooks and trolleys are used for moving carcasses on the dressing rail. It extends from the rumping, backing, and eviscerating area through the weighing area.

Knocking pen.—This pen is used for holding cattle while they are being stunned. All cattle and calves would be driven into the pen for stun-

ning except crippled animals which are loaded directly onto the killing floor for stunning.

The proposed knocking pen is 3 by 12 feet at its top. It is 5 feet 6 inches deep. Along the side of the pen near the wall, a 2- by 12-foot platform, 4 feet above the level of the knocking pen floor, should be constructed to provide working space for the immobilizer. The side of the pen adjacent to the platform should be sloped so that the bottom of the pen is only 2 feet wide. The opposite side should have a 5- by 8-foot revolving door. The door should be suspended on a central axis and should latch at the top. This door allows the animal to be moved through the lower half of the pen onto the dry landing area. The floor of the knocking pen should be at least 12 inches above killing floor level and should be constructed with a 3-inch slope to facilitate dumping cattle onto the dry landing area.

The knocking pen has the capacity for 1 animal of heavy weight, 2 of medium weight, or 4 of light weight.

Dry landing area.—This area is used for holding cattle or calves after they are stunned and moved from the knocking pen. It is adjacent to the knocking pen and is 5 by 11 feet. One side is bordered by the knocking pen, one side by the wall of the building, and the other two sides are enclosed with a concrete curb, 4 inches wide and 6 inches high, and a 4-foot-high pipe rail fence.

A door 4 feet wide should be constructed on the wall side of the area to permit crippled animals to be loaded directly onto the dry landing area from trucks. The fence should have an 18-inch opening on one side for the worker immobilizing cattle to enter and leave the area and an 18-inch opening on the other side for moving carcasses to the bleeding pit. The floor should be designed to provide separate drainage to prevent washing the stomach contents into the sticking and bleeding area. Five feet of bleeding rail should be installed over the area and a hoist with an automatic lander should be above the rail for hoisting and automatically landing cattle on the rail.

Bleeding and head skinning area.—This area is adjacent to the dry landing area. It is 10 by 14 feet and is bordered by a raised concrete curb 4 inches wide and 6 inches high to permit separate drainage. The floor should be equipped with a 6-inch-diameter blood and water drain. Cattle are stuck and bled and the heads removed in this area. Thirteen feet of bleeding rail extends over the area. Approximately 6 large animals, 8 medium animals, or 12 small animals may be held on the rail at one time.

Head and pluck workup area.—Generally, the heads are dehorned and flushed, tongues are removed, cheekmeat and headmeat are trimmed, and edible glands are washed and separated in this area. The proposed area is 8 by 35 feet. It should provide space for a 3- by 3-foot head flush cabinet, a sterilizing lavatory, an inspection rack, a 3- by 8-foot head trimming table, a head bone gravity chute (for dropping bones into the hide cellar), and a 3- by 5-foot pluck trimming table. It also provides space for 500-pound tub trucks used as storage containers for byproducts. The arrangement of the equipment in the area is shown in figure 17.

Flooring area.—The hind and forelegs are removed from animals and their bellies and sides are skinned in this area. It should be 15 by 10 feet. It provides space for a 2- by 10-foot skinning cradle, a 2- by 2-foot gravity chute for dropping forelegs and hindlegs into the cellar, a sterilizing lavatory for washing knives, and working space for employees. Six feet of bleeding rail also extends from the bleeding pit to a dropoff point over the skinning cradle.

Rumping, backing, and eviscerating area.—This area is used for skinning the rump and back of a carcass, and removing the viscera. The dressing rail should be installed 16 feet from the dropoff point of the bleeding rail in the skinning bed area to provide for an inspection aisle. A distance of 13 feet along the dressing rail is suggested for the operations. About 7 feet of the rail would be used for holding carcasses before moving them into the next operation. The equipment consists of a hoist and a single rail lander for landing carcasses on the rail.

Dropping hide and sawing carcass area.—This area is used for skinning the hide from the neck, dropping it into a chute, and splitting the carcass into halves. A distance of 14 feet along the dressing rail is suggested for these operations. About 6 feet of the rail space would be used for holding carcasses after dropping hides and prior to sawing carcasses. The equipment consists of a one-level work platform, a 2- by 2-foot hide gravity chute, and a sterilizing lavatory. The sterilizing lavatory would also serve workers in the rumping, backing, and eviscerating operation. A bone dust shield 4 by 10 feet, extending from 8 inches above floor level to the rail level, should be located opposite the sawing platform to prevent bone dust from blowing into other operations.

Washing and shrouding area.—In this area, each half of a carcass is washed and shrouded with a muslin cloth. A distance of 22 feet along the dressing rail is suggested for the operation. Fourteen feet of this rail distance is used for holding sides for inspection prior to washing and shrouding. The equipment includes a two-level work platform, 2 by 10 feet, and a 15-gallon-per-minute hydraulic cattle washer to which 25 feet of water hose with a high pressure nozzle is connected. A wall should be constructed adjacent to this area to prevent wash water from splashing into the knocking pen and dry landing area.

Weighing area.—Weighing, stamping, and recording weight data is the last of the killing floor operations. A distance of 14 feet along the dressing rail is suggested for it. Ten of the 14 feet of rail would be used for holding sides of carcasses prior to weighing and moving them into

the chill cooler. Four feet of the rail space is for an overhead track type dial scale with a weighing capacity of 2,250 pounds.

Hide Cellar

The hide cellar should be under the killing floor to provide a gravity flow in removing hides, legs, and head bones from the killing floor. The proposed hide cellar is L-shaped, and is 40 by 27 feet. It contains 1,014 square feet and provides space for curing hides, storing salt, storing legs and head bones, and for loading out hides, legs, and head bones.

Vats are used for storing and curing hides. The sizes of vats and the number needed depend on the time required for curing hides, the storage space per hide, and the plant sales policies. Research studies show that the minimum time required to adequately cure hides (by the method shown) is 30 days, and the storage requirement for hides stored in 4-foot stacks is 1 cubic foot of space per salted hide. The typical plant slaughtering 100 cattle daily sells hides at the end of the curing period, or every 30 days. During a 30-day period, 2,000 hides would be produced in the proposed plant.

Two vats are suggested, on the basis of curing 2,000 hides every 30 days, selling hides at the end of each curing period, and allowing a storage space of 1 cubic foot per salted hide. The vats should be side by side. Both vats should be 4 feet deep. One vat should be 13 by 29 feet, the other, 14 by 26 feet. The two vats provide 2,964 cubic feet of space for curing hides. The walls of the vats should be 6 inches wide and made of concrete. The floors should be of rough concrete and equipped with a drain.

A salt storage bin, 3 feet wide, 14 feet long, and 6 feet deep, should be located at the end of the 14- by 26-foot vat. This location of the bin permits a worker to shovel salt from it into either vat. The bin should also be adjacent to the outer wall of the building and an opening should be provided in the wall so that salt may be transferred from a salt truck with a minimum of labor.

An area 11 by 21 feet is suggested for receiving hides, leg bones, and head bones from the killing floor and for weighing hides and shipping out hides, leg bones, and head bones. Approximately 6 barrels of head bones and 4 barrels of leg bones would be loaded out daily. Therefore, the area should provide space for at least 6 barrels. One barrel would be used for head bones and one for leg bones. The other 4 would be used as replacements when these barrels are filled. Hides would be received from the killing floor in a small area on the floor of the cellar directly in front of the two hide vats.

The floor of the cellar should be constructed of rough-finished concrete and provided with adequate drainage.

A concrete truck approach, the full width of the dock, is suggested for the cellar.

Viscera Washing and Separating Room

The viscera washing and separating room is used for emptying paunches and processing tripe. It should be as near as possible to the rumping, backing, and eviscerating work area so that paunches may be transported to that area with short distances of travel.

The suggested viscera washing and separating room is 17 by 21 feet. The side of the room adjacent to the killing floor should have a 15-foot passageway. The opposite side should have a 5-foot opening onto a dock for loading out inedible products. The dock should be 5 by 25 feet. A 10-foot ramp should be located at each end of the platform to provide workers ready access to the plant and for the movement of barrels (by 2-wheel hand trucks) to and from the dock.

The room provides space for a 5- by 10-foot paunch table, a 4-foot-diameter umbrella-type tripe washer, and a tripe scalder. The washer should be adjacent to the scalder so that tripe can be transferred from the paunch table to the washer with a minimum of handling.

The area of the room in which the tripe scalder is located should be bordered by a 4- by 4-inch concrete curb and equipped with a drain for overflows from the scalder.

Chilling and Holding Coolers

The proposed chilling and holding coolers comprise a compartment 40 by 60 feet. The compartment is divided, by a partition, into two coolers, a chilling cooler and a holding cooler. Adjacent to the partition and in the holding cooler, an area 5 by 26 feet should be provided for refrigeration equipment. Each side of the partition should have a 5-foot door for moving carcasses between the chilling cooler and holding cooler. The chilling cooler is used for holding carcasses while the body temperature is being lowered, and the holding cooler is for storing them until they are sold.

Chilling cooler.—The size of the chilling cooler should be determined by the number of animals killed daily, the weights of the animals, the storage time required for lowering body temperatures, the distances rails should be spaced to prevent carcasses from touching when hanging from rails, the rail space required per carcass for hanging on rail, and the working space needed for moving carcasses into and out of the chilling cooler.

Research studies show that the time required for lowering body temperatures ranges from 18 to 24 hours and is largely dependent on the weights of carcasses. The average weight of the carcasses to be handled by the proposed plant is 440 pounds (the average weight handled by most plants in Texas). For purposes of this study, carcasses averaging 440 pounds would require 24 hours for lowering body temperature.

Research studies also show that the rail space needed per 440-pound carcass is 28 inches and the distance needed between rails to prevent carcasses from touching is 2 feet 6 inches. A distance of 3 feet between the assembly rails and walls usually provides adequate working space for moving carcasses into and out of the chilling cooler.

A chill cooler 40 by 22 feet is suggested. This is based on killing 100 cattle daily, an average storage period of 24 hours, a rail storage space of 28 inches per carcass, a rail spacing of 2 feet 6 inches, and an allowance of 3 feet between the assembly rail and walls for working space. This size chill cooler allows for a system of 8 parallel overhead rails 34 feet long. The system provides 272 feet of rail for storing carcasses. Based on 28 inches per carcass, the cooler would hold 116 carcasses.

The cooler should adjoin the killing floor, so that carcasses may be moved into it, after they are weighed, with short transport distances. The entrance door from the killing floor should be 5 feet wide.

The cooler should be equipped with a 4- by 8-foot collapsible steel cage for holding carcasses or products specified by inspection. The cage should be located in the corner of the cooler and should be folded against the wall when not in use.

Holding cooler.—After the body temperature has been lowered, carcasses are moved into the holding cooler and held until they are sold. Because of market conditions, the length of time carcasses are held in this cooler varies widely among plants. Studies indicate that the average carcass is held in the cooler 48 hours. Studies also show that rails should be spaced 2 feet 6 inches apart and the rail storage requirement is 24 inches per carcass.

A holding cooler 40 by 33 feet is suggested. This is based on storing carcasses 48 hours, a rail spacing of 2 feet 6 inches, a rail storage requirement of 24 inches, and an allowance of 3 feet between the assembly rail and walls for working space. This size allows for a system of 12 parallel overhead rails 34 feet long. The system provides 408 feet of rail for storing carcasses. Based on 24 inches per carcass, the cooler would have the storage capacity for 200 carcasses.

Boning Room

The boning room is used for removing meat from the bones of carcasses and boxing the meat for shipment. The room should be as close as possible to both the load-out dock and the holding cooler. The location should also permit easy access to a freezer room and dry storage area. An extension of the load-out dock rail should run into the boning room to allow carcasses to be easily transported to the room.

The suggested boning room is 23 by 19 feet. A 5-foot-wide door opens onto the load-out dock. Carcasses are moved through this door on an overhead rail to a point directly over the boning tables. Rail storage space for 5 carcasses is provided. Two 4- by 8-foot boning tables are in one corner of the room. A band saw, used for sawing carcasses into primal cuts, should be near the boning tables and the overhead storage rail, so that carcasses can be quartered, sawed, and placed on the tables for boning with a minimum of handling. The room should also provide storage space for 7 tub trucks for handling meat products. A 3- by 10-foot packaging table and bench scale should be at the opposite end of the room for packaging meat for shipment.

Load-Out Dock

The load-out dock should be a refrigerated area in the plant. It should be as near as possible to the holding cooler, boning room, and offal chilling cooler, so that meat products stored in the department can be loaded out via short transporting distances. It should also be near the office to minimize record keeping labor requirements.

The suggested load-out dock is 8 by 51 feet. It connects directly with the boning room, the edible offal room, and the office. A passageway, 6 by 15 feet, for assembling carcass orders and weighing carcasses, connects the load-out dock with the holding cooler.

The docks should be equipped with 2 rails. One rail, 41 feet long, would extend from the scale to the load-out points on the dock. This rail would be used for moving carcasses from the weighing area onto trucks. The other rail, 24 feet long, would be used for transporting trolleys to the equipment washroom. A dial-type floor scale should be located on the dock, for weighing meat products shipped in bulk form. Two load-out points are suggested; both should be equipped with 5-foot sliding doors. The main entrance to the plant should be a 3-foot door to the load-out dock. It is suggested that this door be accessible from the outside by steps and a ramp.

Offal Chilling Cooler

Research studies show that the most efficient location for the offal chilling cooler is as near the killing floor as possible. This permits a minimum of transporting and handling of edible offal.

An area 16 by 14 feet should be provided for chilling edible offal such as livers, tongues, tripe, and hearts. Two 6-pan offal racks and two 180-hook offal storage racks should be in this room to allow proper storage and chilling of edible offal.

Two 4½-foot-wide doors should be provided to the offal chilling cooler, one opening onto the killing floor and the other onto the load-out dock.

Equipment Washroom

The suggested equipment washroom has 180 square feet, and is at one end of the load-out dock. Two 4-foot doors open into the room, one from the killing floor and one from the load-out dock.

A 3-section dip vat for cleaning trolleys is installed in the room. A section of overhead rail leads from the load-out dock rails to a point in the room directly over the dip vat. Adequate space is also provided for washing large pieces of equipment such as paunch trucks.

Freezer Room

The freezer room should be adjacent to the boning room. It is used for freezing and storing edible offal and specialty or custom items.

The suggested freezer room is 9 by 18 feet with a 4-foot door opening into the boning room. Wooden racks, for storing packaged items, are located in the room.

Offices

In the proposed layout, the office space is 38 by 15 feet. The area is divided into two offices, each 19 feet long. One area is used as general offices for plant personnel, and the other as inspectors' offices. The general offices should have large glass windows to permit observation of operations on the load-out dock. The inspectors' office area also includes lockers and separate dressing room facilities. Both areas should have toilet facilities.

Machinery Rooms

Two rooms should be provided for machinery and equipment. Each room should have an outside door. One room, 7 by 21 feet is for housing all refrigeration equipment. The other room, 21 by 11 feet, is for housing a boiler and maintenance equipment.

Welfare Room

The welfare room, or employee dressing room, should provide a metal locker, at least 15 by 18 by 60 inches, for each employee. Toilet and shower facilities are also provided. The dressing or locker room area should be separated from the toilet and shower stalls by full-height walls or partitions.

The suggested welfare room is of frame construction. Inner walls, floors, and ceiling should be of an impervious material, such as concrete, glazed tile, or portland cement plastic. The room is built as a second floor over the viscera washing and separating room. Outside access to the room is provided by a flight of stairs from the ground level near the dock ramp.

Condemned Products Room

A condemned products room, 13 by 17 feet, is adjacent to the killing floor. Twenty-three feet of dressing rail leads into the room from the hide dropping area on the killing floor to permit condemned carcasses to be moved directly into the room. Sufficient space is provided in the room for sterilizing paunch trucks used in moving condemned viscera. A 4-foot door opens onto the inedible-offal dock to allow barrels of condemned material to be positioned for shipping to a rendering plant.

Storage Room

The suggested storage room is 9 by 18 feet, has a door opening into the boning room, and is adjacent to the freezer room. The storage room is used for general supplies, such as boxes, strapping, extra trolleys, aprons, shrouds, and other items necessary for the operation of the plant.

Expansion of Plant

The layout of the slaughter plant for processing 100 cattle daily (fig. 17) provides for expansion. Figure 18 shows the plant expanded to slaughter 150 cattle daily. For this expansion, changes would be made in four major departments, the holding pens, the killing floor, the chilling and holding coolers, and the hide cellar. Changes would also be necessary in the machinery rooms and storage room.

Twelve additional pens, with 2,400 square feet of space, a large truck-unloading ramp, and a 10- by 120-foot alley would be added to the holding pen area. These 12 pens would provide for holding about 135 cattle. Total pen area would have the capacity for 405 cattle.

An area 7 by 35 feet (245 square feet) would be added to the killing floor. This would provide for enlarging the bleeding pit by 7 feet and adding another skinning cradle. Thus, the plant would become a two-bed plant. An additional 15 feet of dressing rail, with a single rail landing section, would be needed to serve the added cradle. The increased volume would also necessitate a rearrangement of work stations on the killing floor (fig. 18).

A 60- by 16-foot area would be added to the chilling and holding coolers. The expansion would provide rail holding space for 55 carcasses in the chilling cooler and 100 carcasses in the holding cooler, for a total capacity of 170 carcasses of the typical weight group in the chilling cooler and 300 carcasses of the typical weight group in the holding cooler. The enlargement of the coolers also allows for a 16-foot addition to the area provided for refrigeration units.

A 6- by 11-foot area should be added to the receiving space in the hide cellar. Another vat should be provided. The vat would measure 15 by 27 feet and would include a 2- by 14-foot salt storage bin. The vat would provide 1,508 cubic feet of vat space for curing hides.

An additional 16- by 20-foot area would be added to the plant to allow the compressor room to be enlarged by 128 square feet, the storage room by 66 square feet and the boiler and maintenance room by 126 square feet.

If additional space is required for the general office, consideration should be given to the frame construction of a second floor area. The suggested

size of the welfare room would be adequate for additional lockers, if they are necessary.

Total area added to the holding pens is 3,600 square feet. This is a 60 percent increase, and it allows for a 50 percent increase in holding capacity.

Total area added to the plant proper is 1,525 square feet, an increase of approximately 19 percent, to provide for a 50 percent kill capacity increase.

To accomplish the expansion, one interior wall would be removed to enlarge the storage room. It would also be necessary to remove one outside wall and a portion of another. The exterior walls affected are indicated in figure 18.

APPENDIX

Two major tables have been developed as aids in comparing equipment costs and labor requirements. Table 13 shows cost figures for each type of equipment used for performing the various operations. Costs, per 100 cattle were determined for each type of equipment, based on an annual volume of 26,000 animals of the typical weight group slaughtered. Table 14 shows the base and productive times for each time item of plant operations for 100 animals slaughtered in any of the weight groups.

Table 15 shows average productive labor requirements for manually moving carcasses on overhead rails specified distances. Table 16 shows average productive labor requirements for walking specified distances.

TABLE 13.—*Ownership and operating costs of specific types of equipment for a plant slaughtering 100 cattle daily, or 26,000 cattle annually* [1]

Equipment	Amount of equipment	Size or capacity	Initial cost (f.o.b. factory)	Expected life [2]	Ownership cost				Operating cost			Total annual cost	Cost per 100 animals
					Depreciation	Interest (6 percent of average investment)	Insurance and taxes (4 percent of initial investment)	Total	Water and electricity [3]	Maintenance [4]	Total		
			Dollars	*Years*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Killing floor:													
Single shot rifle	1	.22 cal	15.95	1	15.95	0.48	0.64	17.07		5.00	5.00	22.07	[5] 0.0849
Sliding knocking pen door	1		285.00	12	23.75	8.55	11.40	43.70		11.00	11.00	54.70	.2104
Hoist for door	1	1,000 lb	255.00	18	14.17	7.65	10.20	32.02		4.00	4.00	36.02	.1385
Revolving knocking pen door	1		449.35	12	37.45	13.48	17.97	68.90		15.00	15.00	83.90	.3227
Hoist with nonautomatic lander	1	2,000 lb	1,065.00	18	59.17	31.95	42.60	133.72	23.10	11.06	34.16	167.88	.6457
Hoist with automatic lander	1	2,000 lb	1,614.89	18	89.72	48.45	64.60	202.77	20.50	14.61	35.11	237.88	.9149
Shackle return rail	12 feet		12.78	20	.64	.38	.51	1.53		.13	.13	1.66	[6] .0064
Bleeding rail, hangers	42 feet	½" x 3"	165.73	20	8.29	4.97	6.63	19.89		1.66	1.66	21.55	[7] .0829
Bleeding rail, hangers	24 feet	½" x 3"	94.70	20	4.74	2.84	3.79	11.37		.95	.95	12.32	[8] .0474
Blood and water drain	1	6" dia	61.95	20	3.10	1.86	2.48	7.44		.62	.62	8.06	.0310
Friction dropper assembly	1		786.48	18	43.69	23.59	31.46	98.74		12.00	12.00	110.74	.4259
Beef shackles	15	53" long	386.55	10	38.66	11.60	15.46	65.72		3.87	3.87	69.59	[9] .2677
Pritch plates with bar	1 bed	24" x 30"	85.50	20	4.28	2.57	3.42	10.27				10.27	.0395
Cattle cradle	1		135.08	20	6.75	4.05	5.40	16.20				16.20	.0623
Hand meat saw	2		19.20	5	3.85	.58	.77	5.20		36.00	36.00	41.20	.1585
Hoist, double rail spreader	1	2,000 lb	1,230.50	18	68.36	36.92	49.22	154.50	17.63	15.00	32.63	187.13	.7197
Hoist, single rail lander	1	2,000 lb	1,339.82	18	74.43	40.19	53.59	168.21	15.68	13.00	28.68	196.89	.7573
Dressing rail, hangers	73 feet	⅜" x 2½"	77.75	20	3.89	2.33	3.11	9.33		.78	.78	10.11	[10] .0389
Dressing rail switch	1	1-R	13.93	20	.70	.42	.56	1.68		.14	.14	1.82	.0070
Dressing rail, hangers	53 feet	⅜" x 2½"	56.45	20	2.82	1.69	2.26	6.77		.60	.60	7.37	[11] .0283
Beef carcass saw [12]	1	1 HP	1,048.71	15	69.91	31.46	41.95	143.32	13.47	320.00	333.47	476.79	1.8338
Beef carcass saw [13]	1	1 HP	1,048.71	15	69.91	31.46	41.95	143.32	7.96	320.00	327.96	471.28	1.8126
One-level work platform	1	2 ft. x 3 ft.	121.44	20	6.07	3.64	4.86	14.57				14.57	.0560
Hydraulic lift platform	1	1 HP	1,067.00	15	71.13	32.01	42.68	145.82	5.20	106.70	111.90	257.72	.9912
Pneumatic spreader	1	4 ft. spread	424.38	10	42.44	12.73	16.98	72.15		12.00	12.00	84.15	.3237
Saw sterilizer [12 13]	1		115.71	20	5.79	3.47	4.63	13.89				13.89	.0534
Scribe saw [12 13]	1		12.95	5	2.59	3.89	5.18	11.66		15.00	15.00	26.66	.1025
One-level work platform	1	2 ft. x 5 ft	162.50	20	8.13	4.88	6.50	19.51				19.51	.0750
Hydraulic cattle washer	1	15 gal/min	403.52	20	20.18	12.11	16.14	48.43	367.90	27.50	395.40	443.83	1.7070
Two-level work platform	1	2 ft. x 10 ft	449.60	20	22.48	13.49	17.98	53.95				53.95	[14] .2075
One-level work platform	1	2 ft. x 5 ft	204.35	20	10.22	6.13	8.17	24.52				24.52	.0943
Beam track scales	1	2,250 lb	667.00	15	44.46	20.01	26.68	91.15		4.00	4.00	95.15	.3660
Dial track scales	1	1,000 lb	1,050.00	15	70.00	31.50	42.00	143.50		6.00	6.00	149.50	.5750
Head flush cabinet [15]	1	3 ft. x 3 ft.	243.08	20	12.15	7.29	9.72	29.16	3.90	2.00	5.90	35.06	.1348
Head inspection rack [15]	1	8 head	188.43	20	9.42	5.65	7.54	22.61		2.00	2.00	24.61	.0947
Head workup table [15]	1	3 ft. x 8 ft.	356.96	20	17.85	10.71	14.28	42.84	28.00		28.00	70.84	.2725
Paunch truck [16]	2		326.12	15	21.74	9.78	13.04	44.56		4.00	4.00	48.56	.1868
Sterilizing lavatory	3		441.36	20	22.07	13.24	17.65	52.96				52.96	[17] .2037
Trolleys	200	Beef	320.78	10	32.08	9.62	12.83	54.53		3.00	3.00	57.53	[18] .2213
Two-wheel barrel truck	1		70.00	15	4.67	2.10	2.80	9.57		.70	.70	10.27	[19] .0395
Hide room:													
Two-wheel barrel truck	1		70.00	15	4.67	2.10	2.80	9.57		.70	.70	10.27	.0395
Viscera wash and separating room:													
Pluck trimming table [20]	1		202.25	15	13.48	6.07	8.09	27.64	28.00		28.00	55.64	.2140
Sterilizing lavatory [21]	1		147.12	20	7.36	4.41	5.88	17.65				17.65	.0679
Cattle paunch table [21]	1	4 ft. x 13 ft	1,629.60	10	162.96	48.89	65.18	277.03	81.90		81.90	358.93	1.3805
Paunch lift hoist [21]	1	500 lb	231.11	15	15.41	6.93	9.24	31.58		2.00	2.00	33.58	.1292
Umbrella type tripe washer [22]	1		227.17	10	22.72	6.82	9.09	38.63	39.00		39.00	77.63	.2986
Tripe scalder [22]	1	10-15 tripe	1,602.85	10	160.29	48.09	64.11	272.49	12.48	16.00	28.48	300.97	1.1576
Chill and bold cooler:													
Dressing rail [23]	252 feet	¾" x 2½"	268.39	20	13.42	8.05	10.73	32.20		2.69	2.69	34.89	.1341
Dressing rail switches [23]	14	1-L, 1-R	195.02	20	9.75	5.85	7.80	23.40		1.95	1.95	25.35	.0975
Dressing rail [24]	282 feet	⅜" x 2½"	300.33	20	15.02	9.01	12.01	36.04		3.00	3.00	39.04	.1502

See footnotes at end of table.

TABLE 13.—*Ownership and operating costs of specific types of equipment for a plant slaughtering 100 cattle daily, or 26,000 cattle annually* [1]—Continued

Equipment	Amount of equipment	Size or capacity	Initial cost (f.o.b. factory)	Expected life [2]	Ownership cost				Operating cost			Total annual cost	Cost per 100 animals
					Depreciation	Interest (6 percent of average investment)	Insurance and taxes (4 percent of initial investment)	Total	Water and electricity [3]	Maintenance [4]	Total		
Chill and hold cooler—Continued			*Dollars*	*Years*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Dressing rail switches [24]	14	1-R	195.02	20	9.75	5.85	7.80	23.40		1.95	1.95	25.35	0.0975
Dressing rail [25]	213 feet	⅜" x 2½"	226.85	20	11.34	6.81	9.07	27.22		2.27	2.27	29.49	.1134
Dressing rail switches [25]	7	1-L, 1-R	97.51	20	4.88	2.93	3.90	11.71		.98	.98	12.69	.0488
Dressing rail switch [25]	1	3-way	30.00	20	1.50	.90	1.20	3.60		.30	.30	3.90	.0150
Dressing rail [26]	403 feet	⅜" x 2½"	429.20	20	21.46	12.88	17.17	51.51		4.29	4.29	55.80	.2146
Dressing rail switches [26]	22	1-L, 1-R	306.46	20	15.32	9.19	12.26	36.77		3.06	3.06	39.83	.1531
Boning room:													
Dressing rail switch	1	1-L	13.93	20	.70	.42	.56	1.68		.14	.14	1.82	.0700
Dressing rail	24 feet	⅜" x 2½"	25.56	20	1.28	1.07	.77	3.12		.25	.25	3.37	.1296
Boning table	2	4 ft. x 8 ft	700.00	15	46.67	21.00	28.00	95.67				95.67	3.6796
Sterilizing lavatory	1		147.12	20	7.36	4.41	5.88	17.65				17.65	.6788
Band saw	1	2 HP	769.00	10	76.90	23.07	30.76	130.73	5.16	30.00	30.00	165.89	6.3804
Tub trucks	7	500 lb	1,470.00	15	98.00	44.10	58.80	200.90		15.00	15.00	215.90	8.3038
Load-out dock:													
Dressing rail	50 feet	⅜" x 2½"	53.25	20	2.66	1.60	2.13	6.39		.53	.53	6.92	.0296
Dial track scale	1	1,000 lb	1,050.00	15	70.00	31.50	42.00	143.50		6.00	6.00	149.50	.6388
Dressing rail	57 feet	⅜" x 2½"	60.71	20	3.04	1.82	2.43	7.29		.61	.61	7.90	.0338
Trolleys	600	Beef	962.40	20	48.12	28.88	38.50	115.50		10.00	10.00	125.50	[27] .4826
Packaging table	1	3 ft. x 10 ft	146.00	15	9.73	4.38	5.84	19.95				19.95	.7673
Bench scales with stand	1	250 lb	692.00	15	46.13	20.76	27.68	94.57		6.00	6.00	100.57	3.8680
Semilive platform skid	1	2,500 lb	41.65	10	4.17	1.25	1.67	7.09		.42	.42	7.51	.2888
Dial floor scales	1	1,000 lb	985.00	15	65.67	29.55	39.40	134.62		6.00	6.00	140.62	5.4084
Two-wheel barrel truck	1		70.00	15	4.67	2.10	2.80	9.57		.70	.70	10.27	.3950
Offal chill cooler:													
Tub trucks	8	500 lb	1,680.00	15	112.00	50.40	67.20	229.60		16.80	16.80	246.40	.9477
Offal hanging trucks	2	60 hook	500.00	15	33.33	15.00	20.00	68.33		5.00	5.00	73.33	.2820
Tub trucks	6	500 lb	1,260.00	15	84.00	37.80	50.40	172.20		12.60	12.60	184.80	.7108
Offal hanging trucks	3	103 book	750.00	15	30.09	22.50	30.00	102.50		7.50	7.50	10.00	.4231
Offal banging cage (trolley)	2	77 hook	148.50	15	9.90	4.46	5.94	20.30		2.00	2.00	22.30	.0858
Offal panrack [28]	2	6 pan	352.00	15	23.47	10.56	14.08	48.11				48.11	.1850
Offal storage racks	2	180 book	96.60	20	4.83	2.90	3.86	11.59		1.00	1.00	12.59	.0484
Equipment washroom:													
Two-wheel hand truck	2		80.00	15	5.33	2.40	3.20	10.93		.80	.80	11.73	.0451
Trolley storage rack	1	200 trolleys	38.00	15	2.53	1.14	1.52	5.19		.40	.40	5.59	.0215
Dressing rail	10 feet	⅜" x 2½"	10.65	20	.53	.32	.43	1.28		.11	.11	1.39	.0053
Tbree section dip vat with legs [29]	1	2 ft. x 6 ft	362.00	15	24.13	10.86	14.48	49.47				49.47	.1903
Hoist for trolley dip [29]	1	500 lb	250.00	15	16.67	7.50	10.00	34.17		2.50	2.50	36.67	.1410
Dip and transport rack	3		43.00	10	4.30	1.29	1.72	7.31		.45	.45	7.76	.0299
Dressing rail	35 feet	⅜" x 2½"	37.28	20	1.86	1.12	1.49	4.47		.37	.37	4.84	.0186
Dressing rail switch	1	1-L	13.93	20	.70	.42	.56	1.68		.14	.14	1.82	.0070
Cleaning equipment:													
Cleanup hose (present method)	175 feet	¾" I.D	225.00	5	45.00	6.75	9.00	60.75	354.38	2.25	356.63	417.38	1.6053
Cleanup hose (revised method)	175 feet	¾" I.D	225.00	5	45.00	6.75	9.00	60.75	384.54	2.25	386.79	447.54	1.7213

[1] Based on 50 percent weighing from 150 to 349 pounds, 40 percent from 350 to 599 pounds, and 10 percent from 600 to 900 pounds (dressed weight); processing 10 animals daily as boned meat and 90 in carcass form.

[2] Basis for number of years' depreciation. U.S. Internal Revenue Department's Bulletin F.

[3] Based on 2 cents per kw.-hr. for electricity and 0.029 cent per gallon of water.

[4] Based on average costs in Texas.

[5] Cost of shells for rifle not included.

[6] Cost allocation by operation: Dry landing by automatic method $0.0040; flooring by cradle $0.0024.

[7] Cost allocation by operation: Dry landing by nonautomatic method $0.0158; bleeding and head skinning by long rail $0.0513; flooring by pritch plate $0.0158.

[8] Cost allocation by operation: Dry landing by automatic method $0.0099; bleeding and head skinning by short rail $0.0257; flooring by cradle $0.0119.

[9] Cost allocation by operation: Dry landing by automatic method $0.0622; bleeding and head skinning by short rail $0.1705; flooring by cradle $0.0350; dry landing by nonautomatic method $0.0729; bleeding and head skinning by long rail $0.1585; flooring by pritch plate $0.0363.

[10] Cost allocation by operation: Rumping, backing, and eviscerating by split rail $0.0075; dropping bide and sawing carcass by split rail $0.0085; washing by split rail one-level platform $0.0096; shrouding by one-level platform $0.0032; weighing by beam scale $0.0101.

[11] Cost allocation by operation: Rumping, backing, and eviscerating by monorail $0.0037; dropping hide and sawing carcass by the monorail or bydraulic lift $0.0075; washing by monorail two-level platform $0.0059; sbrouding by two-level platform $0.0059; weigbing by dial scale $0.0053.

[12] For dropping bide and sawing carcass by split rail.

[13] For dropping hide and sawing carcass by monorail and bydraulic lift methods.

[14] Cost allocation by operation: Washing by monorail two-level platform $0.1369; sbrouding by two-level platform $0.0706.

[15] For bead workup by two-work station and one-work station methods.

[16] For removing viscera from killing floor by long and short metbods.

[17] Cost allocation by operation: Bleeding and bead skinning by long rail $0.0247; flooring by pritcb plate $0.0556; rumping, backing, and eviscerating by split rail $0.0556; dropping hide and sawing carcass by split rail $0.0278; head workup by two-work station $0.0432; bleeding and bead skinning by short rail $0.0307; flooring by cradle $0.0692; rumping, backing, and eviscerating by monorail $0.0346; dropping hide and sawing carcass by monorail and hydraulic lift metbods $0.0346; bead workup by one-work station $0.0346.

[18] Cost allocation by operation: Flooring by pritch plate $0.0428; rumping, backirg, and eviscerating by split rail $0.0635; dropping bide and sawing carcass by split rail $0.0415; washing by split rail one-level platform $0.0288; shrouding by one-level platform $0.0278; weighing by beam scale $0.0179; flooring by cradle $0.0472; rumpirg, backing, and eviscerating by monorail $0.0580; dropping hide and sawing carcass by monorail and bydrulic lift methods $0.0478; washing by monorail two-level platform $0.0310; shrouding by two-level platform $0.0184; and weigbing by dial scale $0.0189.

[19] Cost allocation by operation: Removing legs by barrel $0.0211; removing bead bores by barrel $0.0184.

[20] For separating pluck by separate work station and combined work station metbods.

[21] For emptying paunches witb slow and fast lift metbods.

[22] For cleaning tripe witb long and sbort transport metbods.

[23] For removing shrouds with manual metbod.

[24] For removing sbrouds by tub truck.

[25] For transporting carcasses by tbe sbort metbod and order assembly by manual metbod.

[26] For transporting carcasses by tbe long metbod and order assembly by on-the-rail method.

[27] Cost allocation by operation: Removing shrouds by manual method $0.1187; transporting carcasses by short transport $0.0531; order assembly by manual transport $0.1496; weigbing and loading out carcasses by quarter stacking $0.1712; removing shrouds by tub truck $0.1352; transporting carcasses by long metbod $0.0854; order assembly by on-tbe-rail metbod $0.1665; weigbing and loading out carcasses by carcass side rail truck $0.1065.

[28] For storing edible offal by combined cooler and separate cooler metbods.

[29] For cleaning trolleys by tbe transport and bang and tbe transport on-tbe-rail metbods.

TABLE 14.—*Productive labor requirements per 100 cattle in plants slaughtering 100 cattle daily of specific weight groups, by time items*

Operation, method, and time item	150 to 349 pounds (dressed weight)				350 to 599 pounds (dressed weight)				600 to 900 pounds (dressed weight)				Typical: 50%, 150–349 lbs.; 40%, 350–599; 10%, 600–900 (dressed weight)			
	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time
	Number	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*
Driving:																
Corner drive method	25	0.96	10	1.05	50	1.90	10	2.09	100	3.79	10	4.17	43	1.61	10	1.77
Straight drive method	25	.81	10	.89	50	1.62	10	1.78	100	3.23	10	3.55	43	1.37	10	1.51
Immobilizing, rifle method	100	.42	10	.46	100	.54	10	.61	100	1.12	10	1.24	100	.53	10	.59
Dumping:																
Sliding door method	25	.10	10	.10	50	.19	10	.22	100	.37	10	.41	43	.15	10	.18
Revolving door method	25	.05	10	.05	50	.10	10	.11	100	.19	10	.21	43	.08	10	.09
Dry landing:																
Nonautomatic method:																
Shackle hind legs of animal	100	.28	15	.32	100	.35	15	.40	100	.38	15	.44	100	.31	15	.36
Hoist animal to bleeding rail	100	.47	10	.52	100	.52	10	.57	100	.64	10	.70	100	.51	10	.56
Transport animal on rail to bleeding pit (av. distance 8 ft.)	100	.17	10	.19	100	.20	10	.22	100	.30	10	.33	100	.20	10	.22
Lower hoist, put shackle on hook	100	.68	10	.75	100	.68	10	.75	100	.68	10	.75	100	.68	10	.75
Walk to bleeding pit (av. distance 15 ft.)	25	.04	10	.04	50	.08	10	.09	100	.15	10	.17	43	.06	10	.07
Total		1.64		1.82		1.83		2.03		2.15		2.39		1.76		1.96
Automatic method:																
Shackle hind legs of animal	100	.28	15	.32	100	.35	15	.40	100	.38	15	.44	100	.31	15	.36
Hoist animal to bleeding rail	100	.37	10	.41	100	.47	10	.52	100	.55	10	.61	100	.43	10	.47
Transport animal on rail to bleeding pit (av. distance 6 ft.)	100	.11	10	.12	100	.14	10	.15	100	.24	10	.26	100	.14	10	.15
Lower hoist, put shackle on hook	100	.42	10	.46	100	.42	10	.46	100	.42	10	.46	100	.42	10	.46
Walk to bleeding pit (av. distance 10 ft.)	25	.03	10	.03	50	.06	10	.07	100	.12	10	.13	43	.05	10	.06
Total		1.21		1.34		1.44		1.60		1.71		1.90		1.35		1.50
Bleeding and head skinning:																
Long rail method:																
Stick and bleed	100	.22	20	.26	100	.27	20	.32	100	.87	25	1.09	100	.31	20	.37
Skin head, remove ears, trim hide	100	1.47	20	1.76	100	2.70	20	3.24	100	6.68	25	8.35	100	2.51	20	3.01
Tag head	100	.37	10	.41	100	.37	10	.41	100	.37	10	.41	100	.37	10	.41
Transport carcass within bleeding pit (av. distance 20 ft.)	100	.26	10	.29	100	.29	10	.32	100	.38	10	.42	100	.29	10	.32
Sterilize knives and wash hands	25	.09	10	.10	50	.16	10	.18	100	.32	10	.35	100	.14	10	.16
Total		2.41		2.82		3.79		4.47		8.62		10.62		3.62		4.27
Short rail method:																
Stick and bleed	100	.23	20	.27	100	.27	20	.32	100	.87	25	1.09	100	.31	20	.37
Skin head, remove ears, trim hide	100	1.47	20	1.76	100	2.70	20	3.24	100	6.68	25	8.35	100	2.51	20	3.01
Tag head	100	.28	10	.31	100	.28	10	.31	100	.37	10	.41	100	.37	10	.41
Transport carcass within bleeding pit (av. distance 10 ft.)	100	.13	10	.14	100	.15	10	.16	100	.19	10	.21	100	.15	10	.16
Sterilize knives and wash hands	25	.12	10	.13	50	.16	10	.18	100	.24	10	.27	43	.11	10	.12
Total		2.23		2.61		3.56		4.21		8.35		10.33		3.45		4.07
Flooring:																
Pritch plate method:																
Transport carcass to pritch plates (av. distance 8 ft.)	100	.16	10	.18	100	.20	10	.22	100	.23	10	.25	100	.18	10	.20
Drop carcass to pritch plates, remove and carry shackle to dry land area (distance 10 ft.)	100	.53	15	.61	100	.55	15	.63	100	.99	15	1.14	100	.63	15	.72
Pritch carcass, return dropper hook	100	.53	15	.61	100	.55	15	.63	100	.95	20	1.14	100	.63	15	.72
Skin one front and hind leg, tie weasand	100	2.10	20	2.52	100	2.17	20	2.60	100	3.19	20	3.83	100	2.23	20	2.68
Skin one front and hind leg, make belly incision	100	2.10	20	2.52	100	2.17	20	2.60	100	3.19	20	3.83	100	2.23	20	2.68
Skin paunch side, saw brisket, attach trolleys to hind legs	100	1.59	25	1.99	100	3.44	30	4.47	100	3.92	30	5.10	100	2.53	30	3.29
Skin pritch side, change pritch to opposite side of carcass, split aitch hone, remove udde	100	2.17	25	2.71	100	3.90	30	5.07	100	4.39	30	5.71	100	3.04	30	3.95
Sterilize knives and wash hands	100	.40	10	.44	100	.40	10	.44	100	.40	10	.44	100	.40	10	.44
Total		9.58		11.58		13.38		16.66		17.26		21.44		11.87		14.68

TABLE 14.—*Productive labor requirements per 100 cattle in plants slaughtering 100 cattle daily of specific weight groups, by time items*—Continued

Operation, method, and time item	150 to 349 pounds (dressed weight)				350 to 599 pounds (dressed weight)				600 to 900 pounds (dressed weight)				Typical: 50%, 150-349 lbs.; 40%, 350-599; 10%, 600-900 (dressed weight)			
	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time
Flooring—Continued																
Cradle method:	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*
Transport carcass into cradle area (av. distance 6 ft.)	100	0.11	10	0.12	100	0.14	10	0.15	100	0.16	10	0.18	100	0.13	010	0.14
Drop carcass into cradle, return dropper hook	100	.50	15	.58	100	.55	15	.63	100	1.09	20	1.31	100	.58	15	.67
Gulde carcass into cradle, remove shackle and place on return shackle rail	100	.50	15	.58	100	.55	15	.63	100	1.09	20	1.31	100	.58	15	.67
Skin forelegs, tie weasand, make belly incision	100	1.82	20	2.28	100	2.45	20	3.06	100	2.72	20	3.40	100	2.25	20	2.70
Skin hind legs, attach trolleys	100	1.82	20	2.28	100	2.45	20	3.06	100	2.72	20	3.40	100	2.25	20	2.70
Skin one side, split aitch bone, remove udder	100	1.41	20	1.69	100	2.95	25	3.70	100	4.00	25	5.00	100	2.26	25	2.83
Skin one side, saw brisket	100	1.50	20	1.80	100	2.78	25	3.48	100	3.94	25	4.93	100	2.23	25	2.79
Sterilize knives and wash hands	100	.33	10	.36	100	.33	10	.36	100	.33	10	.36	100	.33	10	.36
Total		7.99		9.69		12.20		15.07		16.05		19.89		10.61		12.86
Rumping, backing and eviscerating:																
Split rail one worker method:																
Half hoist—lower hoist and spreader in the rumping, backing and eviscerating area; walk 12 ft. to skinning bed area; attach spreader to trolleys on carcass; remove pritch bar from carcass; drag carcass by hoist to rumping, backing and eviscerating area, and hoist carcass to position for rump skinning	100	1.26	20	1.51	100	1.28	20	1.54	100	1.51	20	1.81	100	1.29	20	1.56
Rump skin—slit tail skin; drop the bung; skin hind legs; pull feil; skin rump; pull hide from tail	100	3.53	20	4.24	100	4.02	20	4.82	100	6.06	20	7.27	100	3.98	20	4.78
Back skin—hoist carcass to position for back skinning; skin back down to neck and shoulder area	100	1.21	15	1.39	100	1.68	15	1.93	100	1.80	15	2.07	100	1.45	15	1.67
Position paunch truck under carcass brisket—walk from carcass to paunch truck holding area (av. distance 5 ft.) and move truck to carcass and position it under brisket	100	.20	15	.23	100	.20	15	.23	100	.20	15	.23	100	.20	15	.23
Eviscerate—tie bung, detach intestines, paunch, spleen and pancreas from carcass (except at anterior end) and drop in paunch truck; remove liver and place on tray on truck, cut through diaphram and complete removal of viscera (including lungs, heart, trachea and esophagus) and drop in paunch truck; cut tail from carcass and place on truck tray	100	1.03	15	1.19	100	1.83	15	2.10	100	3.17	15	3.64	100	1.56	15	1.79
Transport paunch truck to holding area—move paunch truck from under carcass brisket to truck holding area (av. distance 5 ft.), and return to eviscerating area	100	.20	15	.23	100	.20	15	.23	100	.20	15	.23	100	.20	15	.23
Transfer carcass to dressing rail—hoist carcass and transfer it onto dressing rail	100	.37	10	.41	100	.55	10	.61	100	.55	10	.61	100	.46	10	.51
Transport carcass on dressing rail to dropping hide and sawing carcass area (av. distance 7 ft.)	100	.08	10	.09	100	.09	10	.10	100	.12	10	.13	100	.09	10	.10
Sterilize knives and wash hands	100	.33	10	.36	100	.33	10	.36	100	.33	10	.36	100	.33	10	.36
Total		8.21		9.65		10.18		11.92		13.94		16.35		9.56		11.23

TABLE 14.—*Productive labor requirements per 100 cattle in plants slaughtering 100 cattle daily of specific weight groups, by time items*—Continued

Operation, method, and time item	150 to 349 pounds (dressed weight)				350 to 599 pounds (dressed weight)				600 to 900 pounds (dressed weight)				Typical: 50%, 150–349 lbs.; 40%, 350–599; 10%, 600–900 (dressed weight)			
	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time
Rumping, backing and eviscerating—Continued																
Split rail two worker method:	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*
Half hoist—same as in one worker method	100	1.26	20	1.51	100	1.28	20	1.54	100	1.51	20	1.81	100	1.29	20	1.56
Rump skin—same as in one worker method	100	3.53	20	4.24	100	4.02	20	4.82	100	6.06	20	7.27	100	3.98	20	4.78
Back skin—same as in one worker method	100	1.21	15	1.39	100	1.68	15	1.93	100	1.80	15	2.07	100	1.45	15	1.67
Eviscerate—same as in one worker method	100	1.03	15	1.19	100	1.83	15	2.10	100	3.17	15	3.64	100	1.56	15	1.79
Transfer carcass to dressing rail—same as in one worker method	100	.37	10	.41	100	.55	10	.61	100	.55	10	.61	100	.46	10	.51
Transport carcass—same as in one worker method	100	.08	10	.09	100	.09	10	.10	100	.12	10	.13	100	.09	10	.10
Sterilize knives and wash hands	50	.15	10	.17	50	.15	10	.17	50	.15	10	.17	50	.15	10	.17
Total		7.63		9.00		9.60		11.27		13.36		15.70		8.98		10.58
Monorail method:																
Half hoist—lower hoist and spreader in rumping, backing and eviscerating area; swing spreader to skinning bed area; attach spreader to trolleys on carcass; drag carcass by hoist to rumping, backing and eviscerating area and hoist carcass to position for rump skinning	100	.91	15	1.05	100	.93	15	1.07	100	1.16	15	1.34	100	.94	15	1.09
Rump skin—same as one worker method	100	3.53	20	4.24	100	4.02	20	4.82	100	6.06	20	7.27	100	3.98	20	4.78
Back skin—same as one worker method	100	1.21	15	1.39	100	1.68	15	1.93	100	1.80	15	2.07	100	1.45	15	1.67
Eviscerate—same as one worker method	100	1.03	15	1.19	100	1.83	15	2.10	100	3.17	15	3.64	100	1.56	15	1.79
Transfer carcass to dressing rail—with single rail lander	100	.18	10	.20	100	.26	10	.29	100	.27	10	.30	100	.23	10	.25
Transport carcass on dressing rail to dropping hide and sawing carcass area (av. distance 10 ft.)	100	.10	10	.11	100	.11	10	.12	100	.14	10	.15	100	.11	10	.12
Sterilize knives and wash hands	50	.16	10	.18	50	.16	10	.18	50	.16	10	.18	50	.16	10	.18
Total		7.12		8.36		8.99		10.51		12.76		14.95		8.43		9.88
Dropping hide and sawing carcass:																
Split rail method:																
Saw carcass to neck area	100	1.30	15	1.50	100	2.39	20	2.87	100	4.84	20	5.81	100	2.07	20	2.48
Drop hide, skin neck, let hide drop to floor	100	2.25	15	2.59	100	2.61	15	3.00	100	3.91	20	4.69	100	2.57	15	2.96
Put hide in barrel	100	.38	15	.44	100	.39	15	.45	100	.42	20	.50	100	.39	15	.45
Saw neck	100	.48	15	.55	100	.58	15	.67	100	.85	15	.98	100	.56	15	.64
Transport carcass to scribe area (av. distance 4 ft.)	100	.06	10	.07	100	.07	10	.08	100	.09	10	.10	100	.07	10	.08
Scribe	100	.38	10	.42	100	.54	10	.60	100	.60	10	.66	100	.47	10	.52
Sterilize knives and wash hands	50	.20	10	.22	50	.20	10	.22	50	.20	10	.22	50	.20	10	.22
Total		5.05		5.79		6.78		7.89		10.91		12.96		6.33		7.35
Monorail method:																
Drop hide, skin neck, let hide drop on floor	100	2.25	15	2.59	100	2.61	15	3.00	100	3.91	20	4.69	100	2.57	15	2.96
Put hide in chute	100	.14	15	.16	100	.15	15	.17	100	.16	15	.19	100	.15	15	.17
Transport carcass on rail to carcass sawing area (av. distance 10 ft.)	100	.20	10	.22	100	.21	10	.23	100	.25	10	.28	100	.21	10	.23
Spread carcass	100	.18	15	.21	100	.20	15	.23	100	.40	15	.46	100	.21	15	.24
Saw carcass, ascend and descend platform	100	1.29	20	1.55	100	1.79	20	2.15	100	5.01	25	6.26	100	1.88	20	2.26
Scribe, move on rail (av. distance 8 ft.)	100	.38	10	.42	100	.54	10	.60	100	.60	10	.66	100	.47	10	.52
Sterilize knives and wash hands	50	.16	10	.18	50	.16	10	.18	50	.16	10	.18	50	.16	10	.18
Total		4.60		5.33		5.66		6.56		10.49		12.72		5.65		6.56

TABLE 14.—*Productive labor requirements per 100 cattle in plants slaughtering 100 cattle daily of specific weight groups, by time items*—Continued

Operation, method, and time item	150 to 349 pounds (dressed weight)				350 to 599 pounds (dressed weight)				600 to 900 pounds (dressed weight)				Typical: 50%, 150-349 lbs.; 40%, 350-599; 10%, 600-900 (dressed weight)			
	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time
Dropping hide and sawing carcass—Continued																
Hydraulic lift method:	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*
Drop hide, skin neck, let hide drop on floor	100	2.25	15	2.59	100	2.61	15	3.00	100	3.91	20	4.69	100	2.57	15	2.96
Put hide in chute	100	.14	15	.16	100	.15	15	.17	100	.16	15	.19	100	.15	15	.17
Transport carcass on rail to carcass sawing area (av. distance 10 ft.)	100	.20	10	.22	100	.21	10	.23	100	.25	10	.28	100	.21	10	.23
Saw carcass	100	1.45	15	1.67	100	1.90	15	2.19	100	5.26	15	6.05	100	2.02	15	2.32
Scribe, move on rail (av. distance 8 ft.)	100	.38	10	.42	100	.54	10	.60	100	.60	10	.66	100	.47	10	.52
Sterilize knives and wash hands	50	.16	10	.18	50	.16	10	.18	50	.16	10	.18	50	.16	10	.18
Total		4.58		5.24		5.57		6.37		10.34		12.05		5.43		6.38
Washing:																
Split rail one-level platform method:																
Assemble sides, and move to wash area (av. distance 10 ft.)	50	.24	10	.27	50	.27	10	.30	50	.34	15	.39	50	.26	10	.29
Wash, ascend platform, wash each side, descend platform	50	3.57	10	3.93	50	4.35	10	4.79	50	6.63	10	7.29	50	4.19	10	4.61
Transport sides to shroud area (av. distance 7 ft.)	50	.08	10	.09	50	.09	10	.10	50	.11	15	.13	50	.09	10	.10
Walk to scribe area (av. distance 15 ft.)	50	.08	10	.09	50	.08	10	.09	50	.08	10	.09	50	.08	10	.09
Total		3.97		4.38		4.79		5.28		7.16		7.90		4.62		5.09
Monorail two-level platform method:																
Transport sides to wash area (distance 7 ft.)	50	.08	10	.09	50	.09	10	.10	50	.11	15	.13	50	.09	10	.10
Wash each side of carcass	50	3.27	10	3.60	50	4.04	10	4.44	50	6.16	10	6.78	50	3.86	10	4.25
Total		3.35		3.69		4.13		4.54		6.27		6.91		3.95		4.35
Shrouding:																
One-level platform method:																
Set up—place supply of shrouds on platform	2	.15	15	.17	2	.15	15	.17	2	.15	15	.17	2	.15	15	.17
Shroud sides	50	2.66	15	3.06	50	5.04	15	5.80	50	5.25	15	6.04	50	3.87	15	4.45
Transport sides onto scale (av. distance 8 ft.)	50	.25	10	.28	50	.28	10	.31	50	.32	15	.37	50	.27	10	.30
Total		3.06		3.51		5.47		6.28		5.72		6.58		4.29		4.92
Two-level platform method:																
Set up—place supply of shrouds on platform	2	.15	15	.17	2	.15	15	.17	2	.15	15	.17	2	.15	15	.17
Shroud sides	50	1.69	15	1.94	50	1.82	15	2.09	50	1.82	15	2.09	50	1.76	15	2.02
Transport sides onto scale (av. distance 10 ft.)	50	.29	10	.32	50	.32	10	.35	50	.36	15	.41	50	.31	10	.34
Total		2.13		2.43		2.29		2.61		2.33		2.67		2.22		2.53
Weighing:																
Beam scale method:																
Weigh—balance beam, determine and record weight on tally sheet, write weight on two tags for each carcass	100	1.12	10	1.23	100	1.12	10	1.23	100	1.12	10	1.23	100	1.12	10	1.23
Tag—place tag on foreleg of each half carcass	100	.20	10	.22	100	.20	10	.22	100	.20	10	.22	100	.20	10	.22
Stamp—both halves of carcass	100	.29	10	.32	100	.29	10	.32	100	.29	10	.32	100	.29	10	.32
Transport carcass off track scales (av. distance 5 ft.)	100	.15	10	.17	100	.18	10	.20	100	.25	10	.28	100	.17	10	.1
Transport carcasses to chill room door (av. distance 10 ft.)	50	.13	10	.14	50	.14	10	.15	50	.18	15	.21	50	.14	10	.15
Open chill cooler door—(spring latch) push carcasses 5 feet through door, pull door shut (not latched)	50	.17	15	.20	50	.18	15	.21	50	.21	15	.24	50	.18	15	.21
Transport carcasses into chill cooler (av. distance 40 ft.)	50	.31	10	.34	50	.33	10	.36	50	.43	15	.49	50	.33	10	.36
Walk to shrouding area, open and shut chill cooler door on way (av. distance 60 ft.)	50	.29	10	.32	50	.29	10	.32	50	.29	10	.32	50	.29	10	.32
Total		2.66		2.94		2.73		3.01		2.97		3.31		2.72		3.00

TABLE 14.—*Productive labor requirements per 100 cattle in plants slaughtering 100 cattle daily of specific weight groups, by time items*—Continued

Operation, method, and time item	150 to 349 pounds (dressed weight)				350 to 599 pounds (dressed weight)				600 to 900 pounds (dressed weight)				Typical: 50%, 150-349 lbs.; 40%, 350-599; 10%, 600-900 (dressed weight)			
	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time
	Number	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*
Weighing—Continued																
Dial scale method:																
Weigh—determine and record weight on tally sheet, write weight on two tags for each carcass	100	1.03	10	1.13	100	1.03	10	1.13	100	1.03	10	1.13	100	1.03	10	1.13
Tag—place tag on foreleg of each half carcass	100	.20	10	.22	100	.20	10	.22	100	.20	10	.22	100	.20	10	.22
Stamp both halves of carcass	100	.29	10	.32	100	.29	10	.32	100	.29	10	.32	100	.29	10	.32
Transport carcass off track scales (av. distance 5 ft.)	100	.15	10	.17	100	.18	10	.20	100	.25	10	.28	100	.17	10	.19
Open chill cooler door (spring latch) push carcasses through door, pull door shut (not latched)	50	.17	15	.20	50	.18	15	.21	50	.21	15	.24	50	.18	15	.21
Transport carcass into chill cooler (av. distance 23 ft.)	50	.25	10	.28	50	.27	10	.30	50	.36	15	.42	50	.27	10	.30
Walk to weight area, open and and shut chill cooler door on way (av. distance 40 ft.)	50	.20	10	.22	50	.20	10	.22	50	.20	10	.22	50	.20	10	.22
Total		2.29		2.54		2.35		2.60		2.54		2.83		2.34		2.59
Head workup:																
Two work station method:																
Set-up—place ice and offal containers at head trim station	2	.36	15	.42	2	.42	15	.48	2	.87	15	1.00	2	.43	15	.50
Walk to carcass (av. distance 20 ft.) remove head, carry to head flush cabinet (av. distance 15 ft.), place head on rack	100	.51	10	.56	100	.56	10	.62	100	.57	15	.66	100	.55	10	.60
Flush heads—dehorn with hand saw	100	1.18	15	1.36	100	1.79	15	2.06	100	2.23	15	2.56	100	1.53	15	1.76
Transport heads—carry heads from head flush cabinet to head inspection rack (av. distance 7 ft.)	100	.10	10	.11	100	.12	10	.13	100	.15	15	.17	100	.12	10	.12
Drop tongues—cut hyoid bones, remove tonsils, loosen tongue and let hang by forejaw, wash heads	25	1.22	10	1.34	25	1.22	10	1.34	25	1.22	10	1.34	25	1.22	10	1.34
Transport heads—walk to head inspection rack (av. distance 20 ft.), pick up heads, and carry to head workup table (av. distance 20 ft.)	50	.22	15	.25	50	.28	15	.32	50	.46	20	.55	50	.27	15	.31
Trim heads—remove head and cheek meat and lips, separate jaws, throw head hones in barrel	100	3.23	15	3.71	100	3.23	15	3.71	100	3.34	15	3.84	100	3.24	15	3.72
Sterilize knives and wash hands	25	.13	10	.14	25	.13	10	.14	25	.13	10	.14	25	.13	10	.14
Total		6.95		7.89		7.75		8.80		8.97		10.26		7.49		8.49
One-work station method:																
Set-up—place ice and offal containers at head trimming station	2	.36	15	.42	2	.42	15	.48	2	.87	15	1.00	2	.43	15	.50
Transport heads—walk (av. distance 5 ft.) to carcass, remove head, carry 5 ft. to head flush cabinet, place head on rack	100	.16	10	.18	100	.22	10	.24	100	.26	10	.29	100	.20	10	.22
Flush heads—dehorn with hand saw	100	1.18	15	1.36	100	1.79	15	2.06	100	2.23	15	2.56	100	1.53	15	1.76
Transport heads—carry heads from head flush cabinet to head inspection rack (av. distance 5 ft.)	100	.08	10	.09	100	.10	10	.11	100	.13	15	.15	100	.09	10	.10
Drop tongues—same as two work station method	25	1.22	10	1.34	25	1.22	10	1.34	25	1.22	10	1.34	25	1.22	10	1.34
Transport heads—carry heads to head workup table (av. distance 7 ft.) 2 head per trip	50	.09	15	.11	50	.12	15	.14	50	.13	20	.15	50	.11	15	.13
Trim heads—remove head and cheek meat and lips, separate jaws and throw head hones into chute	100	3.23	15	3.71	100	3.23	15	3.71	100	3.34	15	3.84	100	3.24	15	3.72
Sterilize knives and wash hands	25	.08	10	.09	25	.08	10	.09	25	.08	10	.09	25	.08	10	.09
Total		6.40		7.30		7.18		8.17		8.26		9.42		6.90		7.86
Removing legs from the killing floor, barrel method	2	.04	15	.05	5	.09	15	.10	10	.16	15	.19	4	.07	15	.08

TABLE 14.—*Productive labor requirements per 100 cattle in plants slaughtering 100 cattle daily of specific weight groups, by time items*—Continued

Operation, method, and time item	150 to 349 pounds (dressed weight)				350 to 599 pounds (dressed weight)				600 to 900 pounds (dressed weight)				Typical: 50%, 150-349 lbs.; 40%, 350-599; 10%, 600-900 (dressed weight)			
	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time
	Number	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*
Removing viscera from the killing floor:																
Long transport method:																
Transport paunch truck to pluck table—walk to paunch truck holding area at eviscerating work station (av. distance 35 ft.) and push loaded truck to pluck table (av. distance 20 ft.)	100	0.50	15	0.58	100	0.50	15	0.58	100	0.50	15	0.58	100	0.50	15	0.58
Place pluck on pluck trimming table	100	.07	10	.08	100	.07	10	.08	100	.07	10	.08	100	.07	10	.08
Transport viscera via paunch truck from pluck table to paunch table in viscera washing and separating room (av. distance 15 ft.)	100	.24	15	.28	100	.24	15	.28	100	.24	15	.28	100	.24	15	.28
Separate paunch from viscera and dump paunch on paunch lift, place remaining viscera in barrel	100	.52	15	.60	100	.61	15	.70	100	.67	15	.77	100	.57	15	.66
Transport paunch truck to rinse area (av. distance 5 ft.)	100	.12	10	.13	100	.12	10	.13	100	.12	10	.13	100	.12	10	.13
Rinse paunch truck	100	.21	10	.23	100	.21	10	.23	100	.21	10	.23	100	.21	10	.23
Transport paunch truck to holding area at eviscerating work station (av. distance 35 ft.), return to paunch table in viscera washing and separating room (av. distance 35 ft.)	100	.60	10	.66	100	.60	10	.66	100	.60	10	.66	100	.60	10	.66
Total		2.26		2.56		2.35		2.66		2.41		2.73		2.31		2.62
Short transport method:																
Transport paunch truck from under carcass brisket to pluck table (av. distance 15 ft.)	100	.17	15	.20	100	.17	15	.20	100	.17	15	.20	100	.17	15	.20
Place pluck on pluck trimming table	100	.07	10	.08	100	.07	10	.08	100	.07	10	.08	100	.07	10	.08
Transport paunch truck from pluck trimming table to paunch table in viscera washing and separating room (av. distance 10 ft.)	100	.17	15	.20	100	.17	15	.20	100	.17	15	.20	100	.17	15	.20
Separate paunch from viscera and dump paunch on paunch lift, place remaining viscera in barrel	100	.52	15	.60	100	.61	15	.70	100	.67	15	.77	100	.57	15	.66
Transport paunch truck—empty to rinse area (av. distance 15 ft.)	100	.18	10	.20	100	.18	10	.20	100	.18	10	.20	100	.18	10	.20
Rinse truck	100	.21	10	.23	100	.21	10	.23	100	.21	10	.23	100	.21	10	.23
Transport truck to eviscerating area—push empty paunch truck to carcass and position under brisket (av. distance 20 ft.)	100	.22	10	.24	100	.22	10	.24	100	.22	10	.24	100	.22	10	.24
Total		1.54		1.75		1.63		1.85		1.69		1.92		1.59		1.81
Removing head bones from the killing floor: barrel method	4	.04	10	.05	9	.10	10	.11	13	.14	10	.16	6	.06	10	.07
Storing hides:																
Barrel and hide house method:																
Transport hides from dropping hide and carcass sawing area by barrel truck to hide house (av. distance 75 ft.)	6	.14	15	.16	10	.22	15	.26	13	.29	15	.34	8	.19	15	.22
Empty barrels of hides onto hide house floor	6	.03	15	.03	10	.04	15	.05	13	.06	15	.07	8	.03	15	.04
Place hides on table	100	.55	15	.63	100	.55	15	.63	100	.55	20	.66	100	.55	15	.63
Trim and spread hide in vat, hair down	100	1.79	15	2.06	100	1.79	15	2.06	100	1.79	20	2.15	100	1.79	15	2.07
Shovel salt over hide	100	.33	20	.40	100	.33	20	.40	100	.33	20	.40	100	.33	20	.40
Total		2.84		3.28		2.93		3.40		3.02		3.62		2.89		3.36
Gravity chute and hide cellar method:																
Trim and spread hide in vat, hair down	100	1.79	15	2.06	100	1.79	15	2.06	100	1.79	20	2.15	100	1.79	15	2.07
Shovel salt over hide	100	.33	20	.40	100	.33	20	.40	100	.33	20	.40	100	.33	20	.40
Total		2.12		2.46		2.12		2.46		2.12		2.55		2.12		2.47

TABLE 14.—*Productive labor requirements per 100 cattle in plants slaughtering 100 cattle daily of specific weight groups, by time items*—Continued

Operation, method, and time item	150 to 349 pounds (dressed weight)				350 to 599 pounds (dressed weight)				600 to 900 pounds (dressed weight)				Typical: 50%, 150–349 lbs.; 40%, 350–599; 10%, 600–900 (dressed weight)			
	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time
	Number	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*
Separate plucks:																
Combined work station method	100	2.30	10	2.53	100	2.30	10	2.53	100	2.30	10	2.53	100	2.30	10	2.53
Separate work station method	100	2.16	10	2.37	100	2.16	10	2.37	100	2.16	10	2.37	100	2.16	10	2.37
Emptying paunches:																
Slow lift method:																
Dump paunches onto table—ascend work platform, raise paunch lift, dump paunches (17 ft. per minute lifting rate), lower lift to floor level	100	1.07	10	1.18	100	1.07	10	1.18	100	1.07	10	1.18	100	1.07	10	1.18
Empty paunches—open paunches with hand knife, dump and wash contents into hopper, carry tripe to umbrella washer	100	1.50	15	1.73	100	1.75	15	2.01	100	2.09	15	2.40	100	1.66	15	1.91
Total		2.57		2.91		2.82		3.19		3.16		3.58		2.73		3.09
Fast lift method:																
Dump paunches onto table—ascend work platform, raise paunch lift to dump paunches (34 ft. per minute lifting rate), lower lift to floor level	100	.64	10	.70	100	.64	10	.70	100	.64	10	.70	100	.64	10	.70
Empty paunches—same as slow lift method	100	1.50	15	1.73	100	1.75	15	2.01	100	2.09	15	2.40	100	1.66	15	1.9
Total		2.14		2.43		2.39		2.71		2.73		3.10		2.30		2.61
Cleaning tripe:																
Long transport method:																
Wash and scrape tripe	100	1.45	15	1.67	100	1.45	15	1.67	100	1.45	15	1.67	100	1.45	15	1.67
Load scalder—put tripe in machine	8	.18	15	.21	8	.18	15	.21	8	.18	15	.21	8	.18	15	.21
Roll barrels of inedible offal to dock, return barrel (av. distance 30 ft.)	16	.24	15	.28	18	.32	15	.36	20	.55	15	.62	17	.29	15	.33
Unload scalder—put tripe in tub truck	8	.17	10	.19	8	.17	10	.19	8	.17	10	.19	8	.17	10	.19
Total		2.04		2.35		2.12		2.43		2.35		2.69		2.09		2.40
Short transport method:																
Wash and scrape tripe	100	1.45	15	1.67	100	1.45	15	1.67	100	1.45	15	1.67	100	1.45	15	1.67
Load scalder—put tripe in machine	8	.18	15	.21	8	.18	15	.21	8	.18	15	.21	8	.18	15	.21
Roll barrels of inedible offal to dock, return empty barrel (av. distance 10 ft.)	16	.18	15	.21	18	.19	15	.22	20	.22	15	.25	17	.19	15	.22
Unload scalder—put tripe in tub truck	8	.17	10	.19	8	.17	10	.19	8	.17	10	.19	8	.17	10	.19
Total		1.98		2.28		1.99		2.29		2.02		2.32		1.99		2.29
Removing shrouds:																
Manual method:																
Remove shrouds—pull pins, holding shrouds, let shroud drop to floor	100	.91	10	1.00	100	.91	10	1.00	100	.91	10	1.00	100	.91	10	1.00
Pick up shrouds from floor and manually transport to load-out dock (av. distance 70 ft.)	5	.33	10	.36	5	.33	10	.36	5	.33	10	.36	5	.33	10	.36
Total		1.24		1.36		1.24		1.36		1.24		1.36		1.24		1.36
Tub truck method:																
Remove shrouds—pull pins holding shrouds, and let shroud drop to floor	100	.91	10	1.00	100	.91	10	1.00	100	.91	10	1.00	100	.91	10	1.00
Pick up shrouds—place in tub truck and transport to load-out dock (av. distance 50 ft.)	1	.23	10	.25	1	.23	10	.25	1	.23	10	.25	1	.23	10	.25
Total		1.14		1.25		1.14		1.25		1.14		1.25		1.14		1.25

TABLE 14.—*Productive labor requirements per 100 cattle in plants slaughtering 100 cattle daily of specific weight groups, by time items*—Continued

Operation, method, and time item	150 to 349 pounds (dressed weight)				350 to 599 pounds (dressed weight)				600 to 900 pounds (dressed weight)				Typical: 50%, 150-349 lbs.; 40%, 350-599; 10%, 600-900 (dressed weight)			
	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time
	Number	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*
Transporting carcasses:																
Short transport method	50	0.53	10	0.58	50	0.56	10	0.61	50	0.65	15	0.76	50	0.56	10	0.61
Long transport method	50	.66	10	.73	50	.74	10	.81	50	.87	15	1.00	50	.72	10	.79
Order Assembly:																
Manual transport method:																
Transport carcasses—4 workers manually transport sides of a carcass to the cooler working rail (av. distance 10 ft.)	200	5.36	20	6.44	200	5.60	25	7.00	200	6.64	30	8.24	200	5.48	25	6.84
Call out order—worker calls out orders and helps crew locate carcasses	100	1.20	10	1.32	100	1.20	10	1.32	100	1.20	10	1.32	100	1.20	10	1.32
Total		6.56		7.76		6.80		8.32		7.84		9.56		6.68		8.16
Transport on-the-rail method:																
Transport carcasses—4 workers transport carcasses on overhead rail to cooler working rail (av. distance 30 ft.)	100	3.90	10	4.29	100	4.23	10	4.65	100	5.19	15	5.97	100	4.17	10	4.59
Call out order—worker calls out orders and helps crew locate carcasses	100	1.20	10	1.32	100	1.20	10	1.32	100	1.20	10	1.32	100	1.20	10	1.32
Total		5.10		5.61		5.43		5.97		6.39		7.29		5.37		5.91
Transporting carcass sides to boning room: [1]																
Manual transport method:																
Transport 20 sides of carcasses from the holding cooler working rail to a point opposite the boning room door (av. distance 45 ft.)	5	.04	10	.04	5	.04	10	.04	5	.05	15	.06	5	.04	10	.04
Quarter sides and manually carry quarters from the point opposite the boning room door to boning table (av. distance 25 ft.)	40	.20	15	.23	40	.22	15	.25	40	.26	20	.31	40	.22	15	.25
Total		.24		.27		.26		.29		.31		.37		.26		.29
Transport on-the-rail method:																
Transport 20 sides of carcasses on overhead rail from holding cooler working rail to boning tables (av. distance 55 ft.) quarter sides and place quarters on table	5	.42	10	.46	5	.46	10	.51	5	.56	15	.64	5	.45	10	.50
Total		.42		.46		.46		.51		.56		.64		.45		.50
Cutting and boning: [1]																
Manual Method:																
Breaking quarters—saw quarters into primal cuts	10	.26	15	.30	10	.39	15	.45	10	.62	15	.71	10	.35	15	.40
Bone primal cuts—remove bones from primal cuts, throw bones into barrels, cut meat into small pieces and throw into tub trucks	10	4.93	15	5.67	10	6.41	15	7.37	10	7.52	15	8.67	10	5.78	15	6.65
Sterilize knives and wash hands	5	.03	10	.03	5	.03	10	.03	5	.03	10	.03	5	.03	10	.03
Total		5.22		6.00		6.83		7.85		8.17		9.40		6.16		7.08
Transporting bones to dock: [1]																
Long transport method	4	.06	15	.07	7	.09	15	.10	10	.12	15	.14	6	.09	15	.10
Short transport method	4	.03	15	.04	7	.07	15	.08	10	.10	15	.12	6	.07	15	.08

See footnotes at end of table.

TABLE 14.—*Productive labor requirements per 100 cattle in plants slaughtering 100 cattle daily of specific weight groups, by time items*—Continued

Operation, method, and time item	150 to 349 pounds (dressed weight)				350 to 599 pounds (dressed weight)				600 to 900 pounds (dressed weight)				Typical: 50%, 150-349 lbs.; 40%, 350-599; 10%, 600-900 (dressed weight)			
	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time
Weighing and loading out carcasses: [2]																
Quarter stacking method:																
Transport carcasses on rail from working rail in holding cooler to dock scale (av. distance 20 ft.) 2 man crew	*Number* 45	*Man-hours* 0.27	*Percent* 10	*Man-hours* 0.30	*Number* 45	*Man-hours* 0.29	*Percent* 10	*Man-hours* 0.32	*Number* 45	*Man-hours* 0.36	*Percent* 15	*Man-hours* 0.42	*Number* 45	*Man-hours* 0.29	*Percent* 10	*Man-hours* 0.32
Weigh—record weight of each carcass	90	.37	10	.41	90	.37	10	.41	90	.37	10	.41	90	.37	10	.41
Transport carcasses off scale, roll grade on each carcass side, partially quarters side	90	.76	10	.84	90	.76	10	.84	90	.76	10	.84	90	.76	10	.84
Transport carcasses—on rail to truck (av. distance 20 ft.) 2 workers	45	.27	10	.30	45	.29	10	.32	45	.37	15	.42	45	.29	10	.32
Load trucks—one worker severs fore and hind quarters with knife and saw, remove trolleys with pike pole and place them in barrel. Two loaders manually carry quarters from rail to truck and stack them inside	90	3.03	15	3.48	90	3.70	15	4.26	90	4.85	20	5.82	90	3.49	15	4.02
Total		4.70		5.33		5.41		6.15		6.71		7.91		5.20		5.91
Carcass side rail truck method:																
Transport carcasses on rails from holding cooler to dock scale (av. distance 35 ft.)—2 workers	45	.62	10	.68	45	.65	10	.72	45	.85	15	.98	45	.66	10	.72
Weigh—record weight of each carcass	90	.37	10	.41	90	.37	10	.41	90	.37	10	.41	90	.37	10	.41
Transport carcasses off scale, roll grade on each carcass side	90	.38	10	.42	90	.38	10	.42	90	.38	10	.42	90	.38	10	.42
Transport carcasses on rail to truck (av. distance 25 ft.)—2 workers	25	.40	10	.44	25	.42	10	.46	25	.56	15	.64	25	.42	10	.46
Load carcasses—one worker pushes carcasses into truck, and one worker positions carcasses in truck	90	.51	10	.56	90	.54	10	.60	90	.71	10	.78	90	.54	10	.60
Total		2.28		2.51		2.36		2.61		2.87		3.23		2.37		2.61
Weighing and loading out boned meat: [1]																
Box method:																
Pack 100 pounds of meat in box—move tub truck with meat to packaging table, pack meat in box and weigh	18	.31	15	.36	33	.56	15	.64	53	.89	15	1.02	28	.47	15	.54
Strap and stencil boxes—load boxes on semilive skids	18	.26	10	.29	33	.47	10	.52	53	.75	10	0.83	28	.39	10	.43
Transport boxes—by skid jack to load-out dock (av distance 30 ft.)	1	.01	20	.01	2	.02	20	.02	2	.02	20	.02	2	.02	20	.02
Load boxes into truck—2 workers manually position boxes on trucks	18	.16	20	.19	33	.28	20	.34	53	.42	20	.50	28	.23	20	.28
Total		.74		.85		1.33		1.52		2.08		2.37		1.11		1.27
Barrel method: [1]																
Transports barrels of meat—by hand truck from boning room to floor scale on load-out dock and weigh (av distance 40 ft.)	5	.11	20	.13	9	.19	20	.23	13	.27	20	.32	7	.15	20	.18
Load barrels on truck—transport barrels by hand truck from scale to truck at load-out dock (av distance 15 ft.), position barrels in truck, return to boning room (av distance 30 ft.)	5	.11	20	.13	9	.19	20	.23	13	.27	20	.32	7	.15	20	.18
Total		.22		.26		38		46		.54		.64		.30		.36

See footnotes at end of table.

TABLE 14.—*Productive labor requirements per 100 cattle in plants slaughtering 100 cattle daily of specific weight groups, by time items*—Continued

Operation, method, and time item	150 to 349 pounds (dressed weight)				350 to 599 pounds (dressed weight)				600 to 900 pounds (dressed weight)				Typical: 50%, 150–349 lbs.; 40%, 350–599; 10%, 600–900 (dressed weight)			
	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time	Frequency of occurrence	Base time	Fatigue and personal allowance	Productive time
	Number	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*	*Number*	*Man-hours*	*Percent*	*Man-hours*
Transporting edible offal:																
Long transport method	15	0.17	15	0.20	15	0.17	15	0.20	15	0.17	15	0.20	15	0.17	15	0.20
Short transport method	10	.09	15	.11	10	.09	15	.11	10	.09	15	.11	10	.09	15	.11
Storing edible offal:																
Combined cooler method:																
Transfer livers from offal hanging truck to offal hanging cage	50	.18	10	.20	50	.18	10	.20	50	.18	10	.20	50	.18	10	.20
Transfer tongues from tub trucks to offal hanging cages, and tail from tub trucks to pan racks	60	.45	15	.52	60	.45	15	.52	60	.45	15	.52	60	.45	15	.52
Total		.63		.72		.63		.72		.63		.72		.63		.72
Separate cooler method:																
Transfer livers, tongues from offal hanging trucks to storage racks	100	.32	15	.37	100	.32	15	.37	100	.32	15	.37	100	.32	15	.37
Transfer tripe from tub trucks to storage racks	100	.18	15	.21	100	.18	15	.21	100	.18	15	.21	100	.18	15	.21
Transfer tails from tub truck to offal pan racks	10	.10	15	.12	10	.10	15	.12	10	.10	15	.12	10	.10	15	.12
Total		.60		.70		.60		.70		.60		.70		.60		.70
Cleaning trolleys:																
Transport and hang method:																
Transport trolleys to washroom—transfer 200 trolleys from barrel on load-out dock to 2 wheel handtruck and transport to washroom (av. distance 120 ft.)	4	0.69	15	0.79	4	0.69	15	0.79	4	0.69	15	0.79	4	0.69	15	0.79
Wash, rinse, and oil trolleys—transfer 200 trolleys from 2-wheel handtruck to hoist; in turn, dip trolleys into vat with cleaning mixture, into vat with rinsing fluid, and into vat with oil	8	.72	15	.83	8	.72	15	.83	8	.72	15	.83	8	.72	15	.83
Transport trolleys to skinning bed area—transfer 200 trolleys from hoist to 2-wheel handtruck, transport to skinning bed area (av. distance 40 ft.) transfer trolleys to rack	4	.85	15	.98	4	.85	15	.98	4	.85	15	.98	4	.85	15	.98
Total		2.26		2.60		2.26		2.60		2.26		2.60		2.26		2.60
Transport on-the-rail method:																
Transport trolleys to washroom—transport 200 trolleys on-the-rail from load-out dock to washroom (av. distance 20 ft.)	2	.09	10	.10	2	.09	10	.10	2	.09	10	.10	2	.09	10	.10
Wash, rinse, and oil trolleys—transfer 200 trolleys from the rail to holding fixture on hoist; in turn, dip trolleys into vat with cleaning mixture, vat with rinsing fluid, and vat with oil	5	.68	10	.75	5	.68	10	.75	5	.68	10	.75	5	.68	10	.75
Transport trolleys to skinning bed area—transfer holding fixture with trolleys to a base with casters, transport 200 trolleys to skinning bed area (av. distance 40 ft.)	5	.10	10	.11	5	.10	10	.11	5	.10	10	.11	5	.10	10	.11
Total		.87		.96		.87		.96		.87		.96		.87		.96

[1] Based on 10 carcasses.
[2] Based on 90 carcasses.

TABLE 15.—*Average productive labor requirements for manually moving carcasses of 100 cattle on overhead rails specified distances, by weight groups* [1]

Distance moved (feet)	150 to 349 pounds (dressed weights)			350 to 599 pounds (dressed weights)			600 to 900 pounds (dressed weights)			Typical weight group		
	Base time	Allowances	Productive time	Base time	Allowances	Productive time	Base time	Allowances	Productive time	Base time	Allowances	Productive time
	Man-hours	*Percent*	*Man-hours*	*Man-hours*	*Percent*	*Man-hours*	*Man-hours*	*Percent*	*Man-hours*	*Man-hours*	*Percent*	*Man-hours*
5	0. 08	10	0. 09	0. 09	10	0. 10	0. 11	15	0. 13	0. 09	10	0. 10
10	. 13	10	. 14	. 14	10	. 15	. 18	15	. 21	. 14	10	. 15
15	. 16	10	. 18	. 18	10	. 20	. 23	15	. 26	. 18	10	. 20
20	. 19	10	. 21	. 20	10	. 22	. 27	15	. 31	. 20	10	. 22
25	. 22	10	. 24	. 24	10	. 26	. 31	15	. 36	. 24	10	. 26
30	. 25	10	. 28	. 27	10	. 30	. 36	15	. 42	. 27	10	. 30
40	. 31	10	. 34	. 33	10	. 36	. 43	15	. 49	. 33	10	. 36
50	. 35	10	. 39	. 39	10	. 43	. 49	15	. 56	. 38	10	. 42
60	. 41	10	. 45	. 45	10	. 50	. 55	15	. 63	. 44	10	. 49
70	. 45	10	. 50	. 51	10	. 56	. 61	15	. 70	. 49	10	. 54
80	. 49	10	. 54	. 56	10	. 62	. 68	15	. 78	. 55	10	. 60
90	. 55	10	. 61	. 62	10	. 68	. 74	15	. 85	. 60	10	. 66
100	. 60	10	. 66	. 68	10	. 75	. 81	15	. 93	. 65	10	. 72

[1] Based on the movement of 2 carcasses or 4 sides per trip (50 percent of the animals weighing from 150 to 349 pounds; 40 percent from 350 to 599 pounds; and 10 percent from 600 to 900 pounds, dressed weight).

TABLE 16.—*Average productive labor requirements for walking specified distances*

Distance walked (feet)	Base time	Fatigue and personal allowance	Productive time
	Man-hours	*Percent*	*Man-hours*
5	0. 0008	10	0. 0009
10	. 0012	10	. 0013
15	. 0015	10	. 0017
20	. 0018	10	. 0020
25	. 0022	10	. 0024
30	. 0025	10	. 0028
35	. 0028	10	. 0031
40	. 0032	10	. 0035
50	. 0038	10	. 0042
60	. 0045	10	. 0050
70	. 0052	10	. 0057
80	. 0058	10	. 0064
90	. 0063	10	. 0069
100	. 0070	10	. 0077
110	. 0077	10	. 0085
120	. 0084	10	. 0092

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